TECHNOLOGY DEPT.

A PICTORIAL SURVEY OF CURRENT PRACTICE, EQUIPMENT AND MATERIALS

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JUN 22 1940
DETROIT

Construction Methods

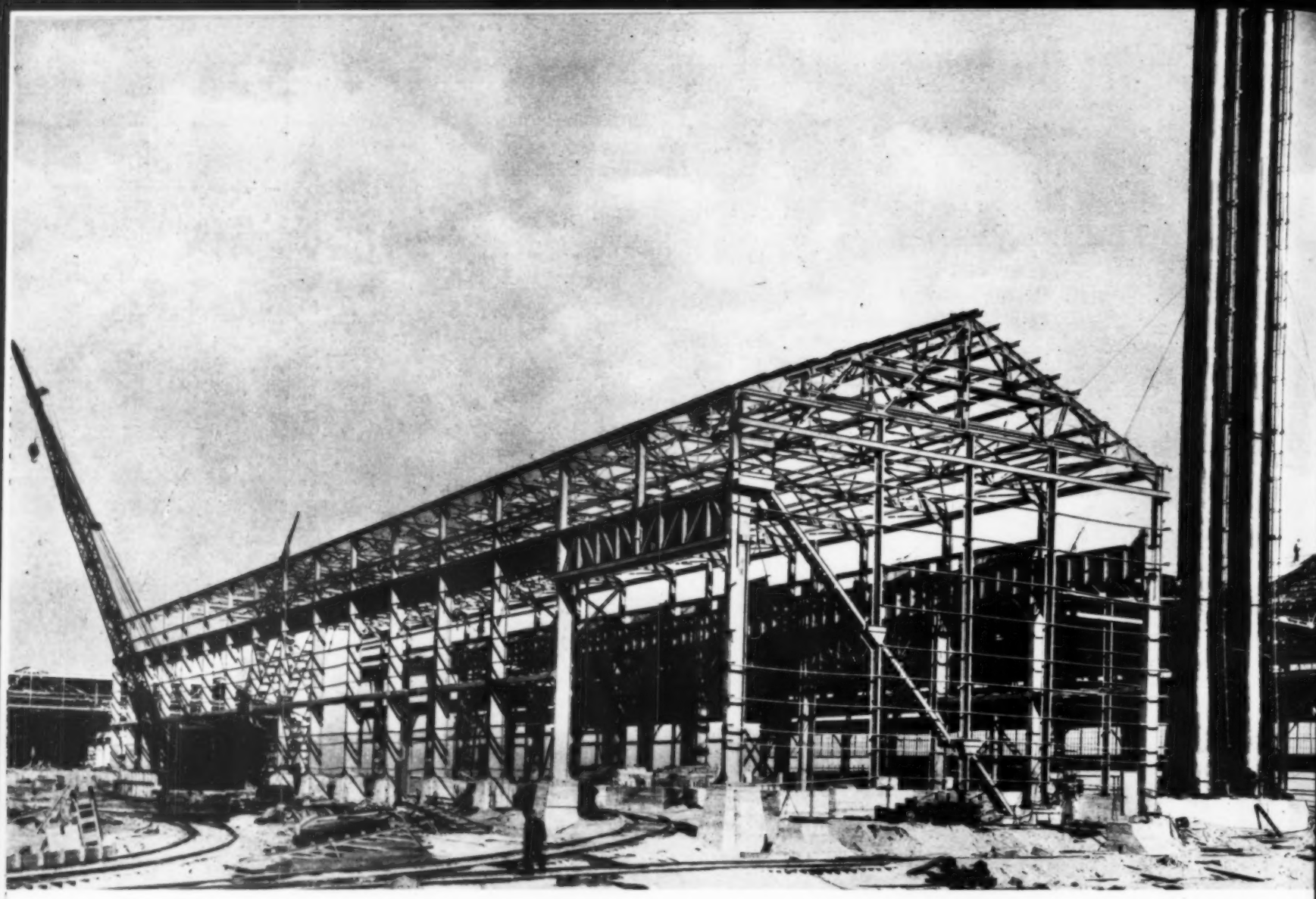
RATCHET JACKS *and aluminum A-frames raise 10-ft. wood panel forms at Watts Bar dam.*

JUNE 1940

Starting a Series of Articles on: WOOD PANEL FORMS FOR CONCRETE DAMS By H. P. MAXTON

HOW TO SELECT AND USE WIRE ROPE SLINGS By W. ELWOOD ROSSNAGEL • ROCK DRILL PRACTICE ON STANISLAUS TUNNEL By GEORGE B. THACHER • JACKS AND ROLLERS MOVE 10,000-TON BUILDING

McGRAW-HILL PUBLISHING COMPANY, INC. • PRICE 20 CENTS



An Opportunity for Fabricators to *Increase* Sales!

Manufacturers of machine tools long ago adopted the sound selling practice of proving to their customers that machine tools of new designs make better products at lower costs. The reward for these alert and untiring sales efforts has been a vastly greater volume of machine tool orders.

Fabricators of structural steel can take that page from the machine tool industry's "success book." Never before have fabricators had so many good arguments, including low interest rates, with which to get new business. Thousands of manufacturing plants are doing business in buildings which are a handicap to efficient manufacturing. Today the industrial architect, contractor and fabricator do far more than simply build. They can make structures that are really "tools" for manufacturing, tools that will give the manufacturer a valuable advantage in lowered costs and higher profits.

Yet, thousands of manufacturers are not fully aware of these facts. Many are struggling along in outmoded structures that are a definite business handicap. Fabricators who will step out and sell structures in which better products can be made at lower cost will open a new realm of opportunity. Inland engineers are especially equipped by many years of practical experience to give fabricators valuable engineering assistance. It is free for the asking.

TECHNOLOGY DEPT.

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38 S. Dearborn Street, Chicago
Sales Offices: Milwaukee, Detroit, St. Paul, St. Louis, Kansas City, Cincinnati

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STRUCTURALS • PILING • RAILS • TRACK ACCESSORIES
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use..

INLAND STRUCTURAL STEEL

CURRENT JOBS

.... and Who's Doing Them

BUILDINGS

Public—Successful bidder for Winton Terrace housing project, comprising 92 buildings, in Cincinnati, Ohio, was **McHugh Construction Co.**, of Chicago, Ill., for $2,586,843. Navy Department awarded $3,047,000 contract for medical center building in Washington, D. C., to **John McShain, Inc.**, of Baltimore, Md. A bid of $2,796,432 obtained for **G. F. Driscoll**, of Brooklyn, N. Y., contract for superstructures and appurtenances for East River Drive houses. In Birmingham, Ala., the Southtown housing project for negroes, consisting of 532 units, will be built by **Rust Engineering Co.**, local contractor, for $1,231,000. Lincoln Park housing project in Denver, Colo. is under construction by **J. E. Dunn Construction Co.**, of Kansas City, Mo., for $836,242 which includes clearing site. Contract for Parkside housing project of 183 dwelling units in Detroit, Mich., to cost $846,457 went to **Bryant & Detwiler**, local contractors. A tuberculosis sanatorium is under construction in Greenwell Springs, La., by **Norman Construction Co.**, of Lake Charles, for $529,213. General contract for public school building in New York City was awarded to **Skolnick Building Corp.**, of New York City, for $520,452. In Spokane, Wash., the **James Leck Co.**, of Minneapolis, Minn., will build a post-office extension for $527,850. **M., S. & S. Construction Co.**, of New York, received general contract for out-patient building at Kings County hospital, Brooklyn, N. Y., for $503,500.

Commercial—In Ottawa, Ont., Canada, hotel is under construction by **Foundation Co. of Canada Ltd.**, of Montreal, Que., for $925,000. The **O. W. Burke Co.**, of Detroit, will build a 3-story department store for Sears, Roebuck & Co. in Wyandotte, Mich., for $500,000. **Edward Corning Co.**, of New York, received contract for $300,000 2-story bank and apartment building in Brooklyn, N. Y. In Baltimore, Md., apartment houses to cost $2,225,000 will be constructed by **A. Lloyd Goode**, of Washington, D. C. General contract for service station addition and altering existing Sears, Roebuck & Co. store in Milwaukee, Wis., went to **Hunzinger Construction Co.**, local contractor, for $500,000. In Montreal, Que. Canada, central passenger terminal will be built by **Dominion Bridge Co. Ltd.**, of Lachine, for $600,000.

Industrial—Contract for brick pharmaceutical manufacturing plant in Belleville, N. J., went to **James Stewart & Co.**, of New York, with tender of $1,000,000. Successful bidder for soap products plant in Dallas, Tex., to cost $1,000,000 was **H. K. Ferguson Co.**, of Cleveland, Ohio. **J. L. Simmons Co., Inc.**, of Indianapolis, Ind., obtained contract for superstructure plant in that city to cost $700,000. **Austin Co.**, of Cleveland, Ohio, submitted $500,000 bid for construction plant addition and office quarters for Vickers, Inc., of Detroit, Mich.

HEAVY CONSTRUCTION

Denison dam in Denison, Tex., will be built for $8,228,465 by **Guy F. Atkinson Co.**, of San Francisco, Calif. A tunnel and outlet for Clearwater dam in Piedmont, Mo., is under way by **United Construction Co.**, of Winona, Minn., for $1,154,798. A rolled-fill earth storage dam in Walla Walla, Wash., will be constructed by **Parker-Schram Co.**, of Portland, Ore., and **Eaton & Smith**, of San Francisco, Calif., for total of $905,570. Successful bidder for Kanopolis dam tunnel contract in Ellsworth, Kansas, was **Morrison-Knudsen Co.**, of Boise, Idaho, for $793,124. A bid of $1,172,470 obtained a contract for subway station in Chicago, Ill., for **Paschen Bros. Construction Co.**, local contractor. Another contract for portion of Chicago subway structures was awarded to **M. J. Boyle & Co.**, of Chicago, for $927,926. **Morrison-Knudsen Co.**, of Los Angeles, Calif., was awarded contract for improving the Los Angeles River in California, for $911,037. Contract for superstructures for Bowery Bay sewage treatment works in New York City, went to **Lane Engineering Co.**, of New York, for $465,502.

HIGHWAYS AND BRIDGES

Among recent highway and bridge contract awards are the following: Alabama: $472,542 to **Vandigriff Construction Co.**, of Montgomery; $236,164 to **Couch Construction Co.**, of Dothan, and **John Oman Construction Co.**, of Nashville, Tenn. California: $667,569 to **Radich & Brown**, of Burbank. Colo.: $215,385 to **Larson Construction Co.**, of Denver. Connecticut: $573,224 to **Osborne & Barnes**, of Danbury. Georgia: $191,804 to **Espy Paving & Construction Co.**, of Savannah; $187,219 to **Pittman Construction Co.**, of Atlanta. Iowa: $231,060 to **Western Contracting Corp.**, of Sioux City. Illinois: $311,284 to **Thornton & Sons**, of Mattoon. Indiana: $265,669 to **Gast Construction Co.**, of Warsaw; $227,412 to **J. C. O'Connor & Sons**, of Ft. Wayne. Louisiana: $236,537 to **Harrison Engineering & Construction Corp.**, of Kansas City, Mo. Michigan: $228,977 to **J. A. McKay & Sons, Inc.**, of Detroit. Mississippi: $263,808 to **Wesco Construction Co.**, Chattanooga, Tenn.; $221,700 to **M. G. Fuller Co.**, of Barnwell, S. C. Montana: $223,651 to **Birch & Sons Construction Co.**, of Great Falls. New York: $207,678 to **H. J. Suits**, of Watkins Glen. Pennsylvania: $192,244 to **Holmes Construction Co.**, of Wooster, Ohio; $327,733 to **Cumberland Construction Co.**, of Cumberland, Md.; $242,897 to **Collins & Maxwell, Inc.**, of Easton. Wisconsin: $221,218 to **J. R. Griffith Co.**, of Racine.

Substructure and superstructure contracts for Niagara Falls bridge, New York, totaling $1,912,053 were awarded to **McLain Construction Co.**, of Buffalo: **Aiken & MacLachten**, of St. Catherines, Canada; **Bethlehem Steel Co.**, of Buffalo; and **Cameron & Phin**, of Ontario, Canada.

JUNE, 1940

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Construction Methods

A Pictorial Survey of Current Practice, Equipment and Materials

ROBERT K. TOMLIN, Editor — A. E. PAXTON, Manager

Editorial Staff: Vincent B. Smith, Paul Wooton (Washington)
N. A. Bowers (San Francisco) Nelle Fitzgerald

A McGRAW-HILL PUBLICATION

The HOW of it

For the benefit of readers concerned with the practical application of method or equipment the following references are to articles or illustrations in this issue that tell:

How **WOOD PANEL FORMS** are designed and used in building large concrete dams. —p. 42
How **PRESSURE OF CONCRETE** against forms is indicated by plotted curves. —p. 42
How **RAISING OF FORMS** for next pour of concrete is done with A-frames and ratchet lever hoists. —p. 43
How **PILE DRIVER LEADS**, 135 ft. in height, are built partly of steel and partly of timber. —p. 45
How **CONCRETE PILE BENTS** supporting boardwalk were extracted and reset with jet points on crane-operated rig.—p. 46
How **JETTING JUMPO** was employed to loosen concrete pile bents. —p. 47
How **CARRIER FRAME** and crane handled 20x40-ft. sections of salvaged boardwalk. —p. 49
How **ADMIXTURES** of natural cement and vinsol resin in concrete pavement were tested. —p. 50
How **HEAVY-DUTY JACKS** helped move 10,000-ton garage building on rollers. —p. 52
How **WELDED STEEL BRACKETS** transferred column loads during moving of building. —p. 53
How **WIRE ROPE SLINGS** are selected and properly used on construction work. —p. 55
How **IMPROVISED SKIPS** for hoisting material were made from halves of boiler shells. —p. 59
How **ELEVATED CONTROL CAB** gave crane operator clear vision for handling clamshell bucket. —p. 60
How **SELF-POWERED SKIP** handled concrete on inclined railway. —p. 60
How **DECK PLATES** for railway track were welded to bridge floor. —p. 60
How **CANVAS TENT** protected concreting of building in cold weather. —p. 61
How **ROAD SHOULDERS** were maintained by truck-drawn drag. —p. 61
How **LAMELLA ROOF** of trussless wood construction provided armory with clear floor. —p. 61
How **PRACTICAL BENCH CLAMP** holds small parts for welding. —p. 61
How **ROCK DRILLING PRACTICE** maintained record speed in 11-mi. tunnel. —p. 62
How **JUMBO** carried five rock drills on tunnel project. —p. 62
How **DRILL STEEL** was held in proper position by centralizer. —p. 63
How **SMALL TOOLS** perform a variety of construction services. —p. 66

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INDUSTRY ORGANIZES
For National Defense

ALERT to what is happening in Europe, the American people are setting out to strengthen their defenses against aggression from any quarter. Already the government has laid down an initial program to that end.

The surest defense against aggression is the ability to resist it. If we are known to be well prepared we may avert attack. If we cannot avert it we shall be armed against it. But preparedness against war means preparedness to wage war.

And modern war is an industry. Like every other industry, it is a matter of men, materials and machines. Fighting men must be skilled workers, trained to use an arsenal of special tools and equipment that are just as diversified and just as essential to success as those of any other industry.

The plant, supplies and personnel of war must rival in efficiency those of any peacetime industry. For the stakes of success or failure in war are not paid in money profits or losses: they are paid in the lives and property of the people, in the security — perhaps the survival — of a nation.

* * *

Sound national defense calls first for a comprehensive program, carefully planned to back up a clear-cut policy as to what we expect to defend. Next comes the appropriation of funds to realize that program. These first steps are vital: they are up to government.

Then program and appropriations must be translated into performance. Native raw materials must be produced, processed and stored. Our meager supplies of strategic materials of foreign origin must be built up until we have accumulated ample stockpiles against the use and wastage of active war. And most urgent, because it is most complicated, raw materials must be manufactured into the innumerable items required to equip the modern army.

We of McGraw-Hill, living with American industry as we do, are keenly aware of the effort that will be required to produce the materials and equipment now needed to modernize our national armament.

Tanks and anti-tank guns, airplanes and anti-aircraft guns, machine guns and automatic rifles, trucks and tractors, destroyers and supply ships — these are but a few items from the endless inventory of military and naval equipment that we must produce by scores, hundreds and thousands, even to arm an Initial Protective Force, behind which we might rally our national resources for decisive effort.

Obviously the army and navy must count on American industry for an ample and continuous supply of this equipment, and industry must organize to produce it in vast quantities. This means the construction and adaptation of manufacturing, transportation and storage facilities, the organization of competent executive and technical staffs, the training of skilled craftsmen in numbers adequate to maintain exacting production schedules. All this, in itself, is an industrial organization problem of the first magnitude, but upon it is imposed still another and vital specification — *sustained speed*.

For time is the all-essential ingredient of modern war. It cannot be bought with any appropriation, however great; once lost, it cannot be recaptured; we must make effective use of it while we still have it. And at this juncture we have none to waste in fumbling, jockeying or experiment.

* * *

Two courses are open to carry out such a program.

1. We might adopt the totalitarian plan of nationalizing industry, conscripting the wealth and labor of all, and suppressing the normal incentives and management of industry in favor of the authority and control of government officials.

2. Or we can stick to the American way of achieving national unity and efficiency by intelligent cooperation between industry, labor and government.

There are those to whom the first will appeal as being the more direct. But I am convinced that most Americans will insist that the job be done in the American way. And in this preference the President, speaking for government, already has indicated his concurrence.

But effective cooperation in so complex and unfamiliar a task demands the utmost of mutual understanding and confidence from all concerned. Confusion of purpose and conflict of opinion are bound to arise — have, indeed, already arisen. Needs and capacities in many fields must be reconciled, relative priorities for various products must be determined, specific parts of the whole program must be allocated, supervised and coordinated with other parts. Government officials, smarting under the whip of urgency, must render quick decisions on highly technical matters, while industrial executives, masters of their own operating technique, must adapt themselves to arbitrary and unfamiliar requirements.

Under such conditions, many problems will arise that must be worked out between the men of industry and those of government. Some of them will be the more acute because of the restrictions under which industry has had to work during recent years — restrictions that have curbed not only the expansion of plant capacity, but also the development of improved processes and the supply of skilled workers. Now, from this sag in our industrial growth, many departments of industry must undertake an overnight expansion of capacity to meet the exacting time schedules of national defense. So industry must look to government for the cooperation that will enable it to expand its facilities promptly and yet write off in reasonable time its heavy emergency investments.

* * *

If we are to deal wisely with these situations, and many more we cannot now foresee, everyone engaged in any part of the defense effort must be willing and able at all times to get a fair understanding of the problems of the others. To help maintain such an understanding McGraw-Hill is peculiarly fitted.

1. By the organized exchange of views and information among our 24 papers, we can help to coordinate the thinking and practice of the 1,000,000 executives, technicians and operating men who are their readers, in matters that have to do with their part in the defense project.

2. Through constant contact with government agencies and the men of industry, our papers can interpret to industry the needs and policies of government and to government the problems and requirements of industry.

3. For the men of industry, each of our papers will expand its regular service as a clearing house of technical and operating data, with special reference to the needs of plants that are producing defense materials and equipment.

To forward these objectives we have set up within our company a National Defense Editorial Board. It is composed of the chief editors of our publications that serve the functions and industries that are of key importance to the defense effort. Made up of men intimately familiar with the personnel and practice of their industries, this board will stimulate and supervise the activities of McGraw-Hill papers insofar as they can contribute to the defense effort. It will outline basic editorial themes, directed to the forwarding of that project, to be adapted by each paper to the special needs of its specific field.

The board will keep close touch with industrial executives and technicians so as to keep abreast of new problems as they arise. It will maintain contact also with government defense agencies and keep our editors posted as to government objectives, plans and problems. Thus it will function as a link between the several governmental defense agencies and the McGraw-Hill editorial organization, and so help each editorial staff to develop a program best suited to the special problems of its industry.

* * *

In thus undertaking our part in an extraordinary industrial effort, we shall not neglect the normal concerns of American industry. So far as may be consistent with the paramount needs of national defense, production and distribution of the goods and services normally consumed by the American people must go on. The effort to mobilize industry for the national defense must be, in large measure, an additional job and an added burden.

That burden is within the capacity of the American people. But it will not be light. And if industry is to carry successfully its heavy share of that burden, it needs the full cooperation of every industrial function.

For more than seventy-five years, through peace and war, McGraw-Hill publications have served to interpret between the various departments of industry and between industry and the American people. Today, as we face these new problems, there is a new and urgent need for interpretation between the industries we serve and the government to which we all bear allegiance. It is fitting that McGraw-Hill should undertake this effort. To it I pledge every resource of our organization.

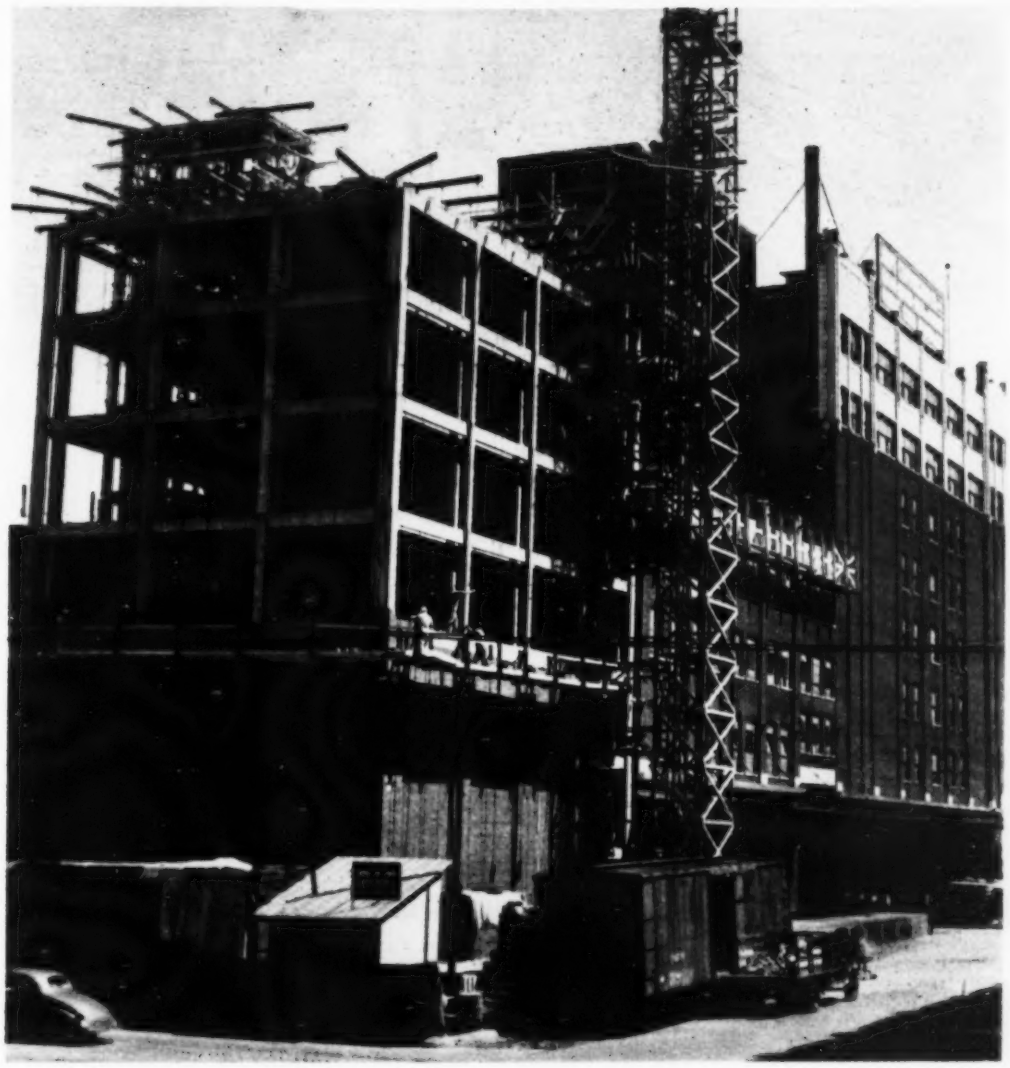
James H. McGraw, Jr.

President, McGraw-Hill Publishing Company, Inc.

This message is appearing in all McGraw-Hill industrial and business publications, reaching over a million readers.

'INCOR' SAVED $1.96 NET

PER CU. YD. OF CONCRETE



6 WEEKS' EARLIER OCCUPANCY EARNED $10,500 FOR OWNER

ONCE again, dependable 'Incor' high early strength produced worthwhile savings—this time in new addition for Jerpe Cold Storage Company, Omaha. This 7-story ice-box contains 1000 cu. yd. of 'Incor' concrete in floor slabs and roof. 'Incor' *net* savings, summarized at right, amounted to $1,965. That means $1.96 per cu. yd. of concrete. And 6 weeks' earlier occupancy meant $10,500 extra income for the owner.

Outside walls are of double concrete frame construction with cork insulation; columns and slabs throughout are covered with cork. Total elapsed time of one month and 8 days for completion of concrete frame indicates good job organization plus 'Incor' operating economies. Heavy rains fell on two of the floors an hour or so after troweling the finished concrete. The contractor states that 'Incor' saved him the cost of re-topping.

Typical of 'Incor's economies in all kinds of concrete work the country over. And a 13-year performance record, exclusive with 'Incor'*, proves long-time durability of this first high early strength Portland cement. Write for copy of "Cutting Concrete Costs." Lone Star Cement Corporation, Room 2266, 342 Madison Avenue, New York.

*Reg. U. S. Pat. Off.

SUMMARY OF 'INCOR' SAVINGS

Addition to Jerpe Cold Storage Co. Building 12th & Dodge Sts., Omaha, Nebraska.

Engineers: Smith, Brubaker & Egan, Chicago.

Contractor: John Lof & Sons, Omaha.

1000 cu. yd. of concrete . . . 7 stories and roof.

Savings to contractor in regular salaries, supervision and overhead—6 weeks at $380	$2280
Savings, 1½ floors of shores .	135
Rain on 2 floors, 'Incor' saved re-topping	300
Total 'Incor' Saving . . .	$2715
Less Extra Cost of 'Incor' .	750
Net Saving	$1965

or $1.96 per cu. yd. of concrete.

* * *

6 weeks' earlier occupancy meant $10,500 extra income for owner.

LONE STAR CEMENT CORPORATION

MAKERS OF LONE STAR CEMENT • • • 'INCOR' 24-HOUR CEMENT

That DAM JOB at Jet

GENERAL VIEW of Great Salt Plains Dam Project . . . for water conservation, flood control, wild-life sanctuary. Texaco lubricated 100%.

THERE ARE 2,700,000 cu. yds. of excavation, a 5,700 ft. earth embankment to build at the Great Salt Plains Dam Project at Jet, Oklahoma.

Mittry Bros. Construction Co., Los Angeles contractor, is using Texaco Fuels and Lubricants 100% on this job.

Texaco Fire-Chief Gasoline and *Insulated Havoline Motor Oil* keep engines free from gum, with rings active to assure piston seal and full power.

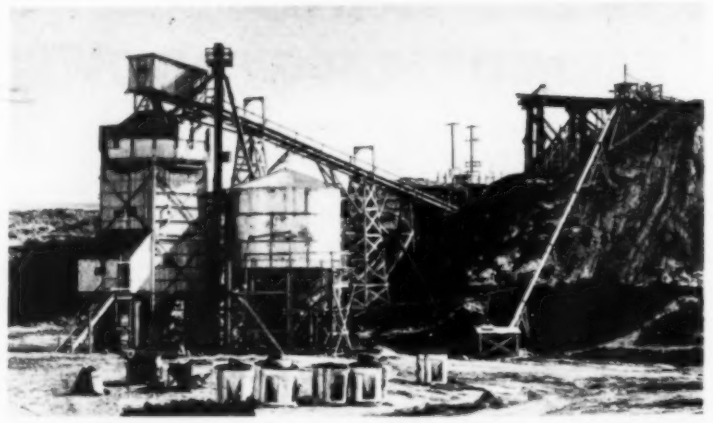
Texaco Marfak protects chassis and wheel bearings of all trucks, tractors, bulldozers, shovels.

Texaco Thuban provides outstanding service in transmissions, differentials and other final drives.

The crankcases of all "Cats" are filled with *Texaco Ursa X*.

You, too, can use Texaco Industrial Lubricants to advantage. A lubrication engineer will gladly demonstrate their savings. Phone the nearest of more than 2300 Texaco warehousing points, or write:

The Texas Company, 135 E. 42nd St., N. Y., N. Y.



SCREENING PLANT at Jet, Okla. Part of job is a man-made lake of 10,000 acres, 9 miles wide. 800 working days' time limit. Fuel and lubricants in use...Texaco.

Texaco Dealers invite you to tune in The Texaco Star Theatre—a full hour of all-star entertainment—Every Wednesday Night—Columbia Network — 9:00 E.D.T., 8:00 E.S.T., 8:00 C.D.T., 7:00 C.S.T., 6:00 M.S.T., 5:00 P.S.T.

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REG. T.M.

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Sepulveda goes EUCLID!

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LOADS PER 16-HR. DAY
FOR
SIX 13-YD. *EUCLIDS*
ON
2700 FT. HAUL ONE WAY

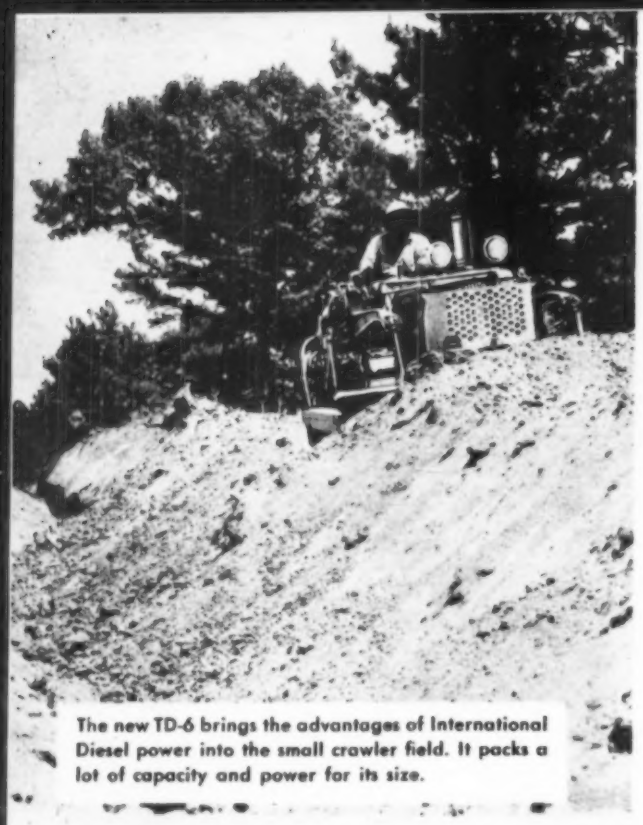
VISIT SEPULVEDA DAM
and see » » »

1. Big easy-loading EUCLIDS utilizing the full capacity of a 48" elevating grader.
2. Peak pay loads carried fast and easily over difficult haul roads by powerful EUCLIDS.
3. The fastest dumping . . . shortest turning . . . most maneuverable earth hauling machine of its size — the 13-Yard Bottom-Dump EUCLID.
4. Efficient top production maintained steadily hour after hour . . . day after day . . . throughout the entire job — by dependable EUCLIDS.

SEPULVEDA CONSTRUCTORS start [illegible] cubic yard Los Angeles Flood Control Dam with six 13-Yard Bottom-Dump EUCLIDS.

THE EUCLID ROAD MACHINERY CO.
CLEVELAND, OHIO U. S. A.

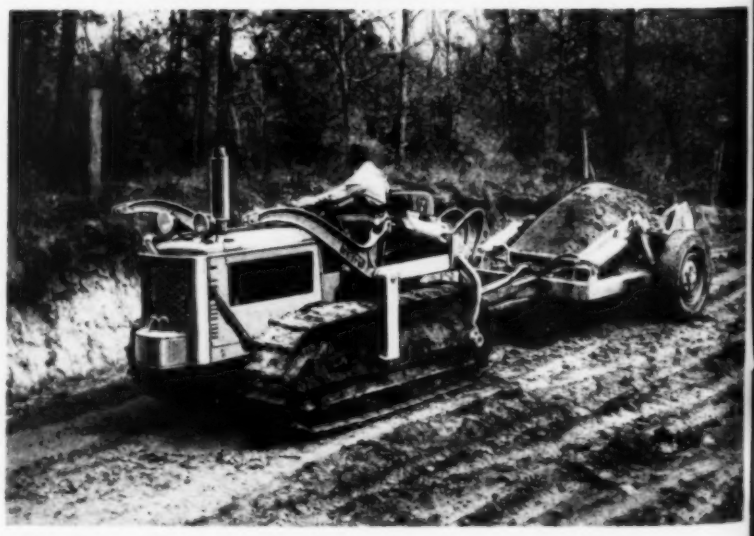
EUCLID
THE PIONEER



The new TD-6 brings the advantages of International Diesel power into the small crawler field. It packs a lot of capacity and power for its size.

POWER THAT BUILDS THE ROADS !

Here's the medium-large Diesel TracTracTor—the new TD-14. It's a powerful crawler for all road work. Powering 6 to 7-yard hauling scrapers, 10 to 12-foot bullgraders, 8 to 10-foot bulldozers, and equipment of comparable size, the TD-14 gives you everything you need for all types of jobs.



The TD-9 operating a 2-wheel scraper, and carrying equipment which can be used for 'dozing when a blade is added.

INTERNATIONAL Industrial Power

INTERNATIONAL DIESELS

• Diesel Power reaches new peaks of efficiency in the *Four New TracTracTors by International Harvester.* Thanks to the ingenuity of Harvester engineers, a higher percentage of their maximum drawbar horsepower can be kept continuously applied to get more work done per day at the lowest possible cost!

In this complete series of DIESEL TracTracTors, you can now get International *design, quality, performance*—and International *full* DIESEL fuel economy — in sizes exactly suited to your power needs. Here's perfectly designed *balanced power* to team up with *balanced allied equipment*—to the profit of everyone.

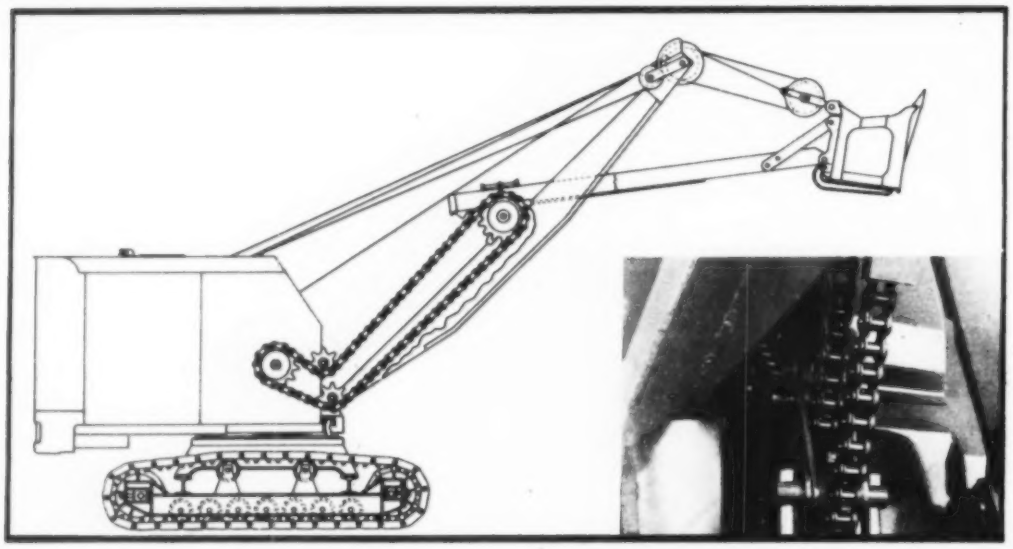
Operator fatigue is engineered out . . . great working capacity, long life, and low maintenance are engineered in. All TracTracTor controls are within easy reach of the driver. Gear shifting is fast and easy. A wide range of traveling speeds provides close selection of speed to load and going. Multiple-disk steering clutches, mounted on ball bearings, are easy to operate. *Exclusive* track frame stabilizer and ball-and-socket pivot construction relieves the pivot shaft and track frames of leverage loads and assures positive track alignment.

Standardize on International Diesel TracTracTors and enjoy all the advantages only Harvester can provide. The nearby International industrial power dealer or Company branch will give you detailed information about this great line of crawlers.

INTERNATIONAL HARVESTER COMPANY
(INCORPORATED)
180 North Michigan Avenue **Chicago, Illinois**

Sold outside U. S. A. by International Harvester Affiliated Companies and Distributors.
Cable Address: Harvester, Chicago

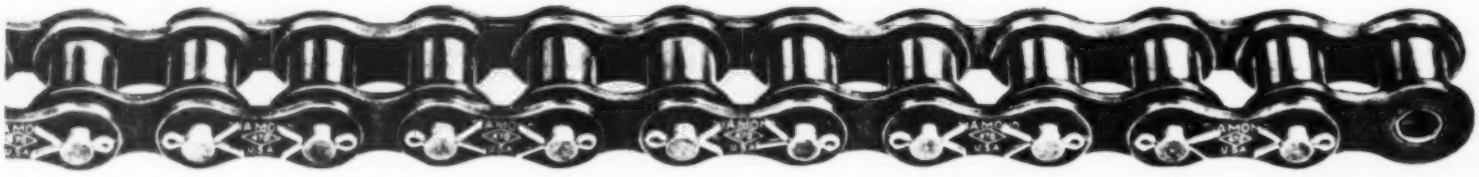
Bigger Performance at Lower Cost



is no idle boast with this

POWERFUL ONE-PIECE CHAIN CROWD

Just as a chain is no stronger than its weakest link — so too, a shovel is no better than its crowd. We have long prided ourselves on the powerful independent and positive one-piece chain crowd which is



standard on all BAY CITY Shovels from ⅜ to 1½ yard.

The superiority of this chain crowd, with automatic chain adjustment, is the logical result of equipping the best type of crowd with the best type of chain—*American Standard, finished steel roller chain.* There are no combined stresses in this chain as pull is transmitted through straight-line simple tension in the flat link plates and not through off-set link plates as in rough or unfinished type roller chain. The chain pins are in shear only—the bushings in compression only.

This is the kind of chain you get in the BAY CITY crowd. No wonder maintenance and operating costs are reduced. Users report ten years or more of continuous service without replacement. Add to this the wider working ranges possible with chain crowd and the answer is bigger, lower-cost performance.

We review here only one of the many outstanding design advantages which are standard construction in the BAY CITY. Let us send you a copy of our 32 page catalog H-2 that tells the complete story.

BAY CITY SHOVELS, Inc., BAY CITY, MICHIGAN

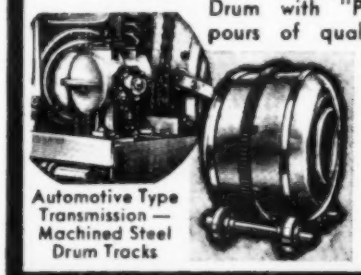
Export Office: 330 W. 42nd St., New York City (OPARO)

BAY CITY

SHOVELS • CRANES • DRAGLINES • TRENCH-HOES • SKIMMERS

DEMAND These Features in Your Concrete Mixer

- AUTOMOTIVE-TYPE TRANSMISSION — fully enclosed, 30% to 40% more efficient, quieter, smoother, longer lived.
- MACHINED, HIGH CARBON STEEL DRUM TRACKS, on chilled, ground "carwheel" rollers, ball bearing shafts.
- Automatic Skip Shaker Loader, Criss-Cross Re-Mixing Drum with "Pressure" Discharge for faster pours of quality concrete — End discharge design, with Shock Absorbers, Timken Bearings, Pneumatic Tires and interchangeable 2 or 4-wheel mounting in sizes up to 14S — Heavy duty service with portability, easy handling.



Automotive Type Transmission — Machined Steel Drum Tracks

Get Catalog, Prices—3½S to 56S

JAEGER MACHINE CO.
800 Dublin Ave., Columbus, Ohio

JAEGER SPEEDLINE

JAEGER, ALONE, Gives You All These Pumping Features

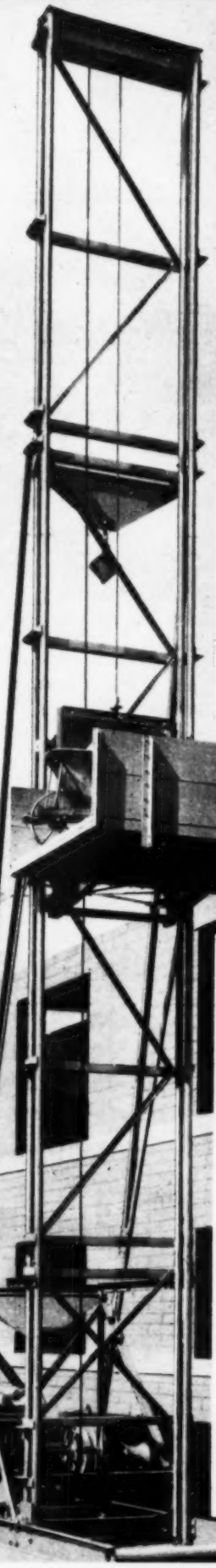
- JAEGER "PRIMING JET"—Up to 5 times faster priming and re-priming—often means difference between profit and loss on job. No adjustments—no need to "gun" engine.
- POSITIVE RECIRCULATION CUT-OFF — It's controlled by flow, not pressure.
- "FULL-RANGE" IMPELLER gives high efficiency under all conditions (built of steel in 4" to 8" sizes).
- ACCESSIBLE SEAL — always outlasts the impeller.
- PATENTED SELF-CLEANING SHELL—scours while pumping, won't clog, easily accessible.
- DEPENDABLE, LONGER LIFE CONSTRUCTION — thousands of EXTRA hours of service.
- EVERY PUMP INDIVIDUALLY TESTED for capacity and pressure before it leaves our factory.

OUTSELLS EVERY OTHER PUMP

Send for New Catalog and Prices
THE JAEGER MACHINE CO.
800 Dublin Avenue - Columbus, Ohio

JAEGER "Sure Prime" PUMPS

Save Up to $45 a Day With JAEGER HOISTER and SELF-RAISING TOWER



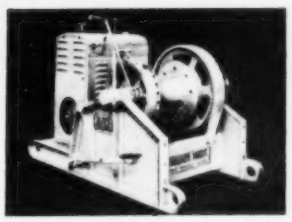
Jaeger Self-Raising Tower, quickly assembled on ground and raised by its 17 H.P. "Hoister," can be moved around job on its own skids — elevates loads up to 2000 lbs. Cage, with Automatic Safety Lock, handles largest concrete cart or 2 barrows. Standard height is 37 ft.—10 ft. sections up to 67 ft. can be added. Saves time, material, labor, pays for itself in no time.

●

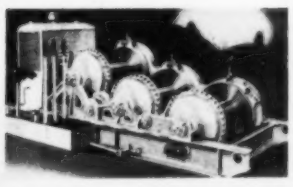
Lawrence Marriana, Philadelphia, did work of 10-12 hodders (costing $52 to $62.40 a day) with 2 wheelers and hoist operator (costing $17.60 a day).

Hoists, 6 to 100 H.P.

Gas, Electric—1, 2 or 3 Drums



Latest features—Touch Control with Giant Expanding Clutches, Anti-Friction Bearings, Combined Side Frames and Base, Smoother Power—all at startling low prices. Get Catalog H-40.



THE JAEGER MACHINE CO. 800 DUBLIN AVENUE COLUMBUS, OHIO

LANOVA *endorses* RPM DELO

DIESEL ENGINE LUBRICATING OIL

—after gruelling tests in high-speed Diesels

Order from Your Nearest Distributor as Listed Below:

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RPM DELO:
The California Company (Montana only)
Humble Oil & Refining Company
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Standard Oil Company of New Jersey
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Kyso RPM DELO:
Standard Oil Company (Inc. in Kentucky)

Signal RPM DELO:
Signal Oil Company

Sohio RPM DELO:
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Imperial RPM DELO:
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RPM DELO is available through distributors in more than 100 countries.

Lanova Corporation minces no words:

"We have used your RPM DELO very successfully in test engines as well as conversion engines under all kinds of adverse engine conditions. We, therefore, recommend it."

One high-speed Diesel after another in the Lanova laboratory showed: RPM DELO stops ring-sticking. RPM DELO stops bearing corrosion. RPM DELO stops sludge trouble. *And RPM DELO is the only oil that does all three!*

What's more it reduces engine wear to a new low because of its unique ability to *spread* and lubricate hot metal surfaces. It never runs away from intense heat as many oils do—never lets engine parts run dry.

Reasons aplenty why RPM DELO is recommended as the *right* oil for all Diesel engines using the Lanova System of controlled combustion. And thousands of test hours—thousands of test miles by leading engine manufacturers prove it for Diesels of every type and size. Give your engines RPM DELO—and profit by it!

RPM DIESEL ENGINE LUBRICATING OIL

Unequaled for every Diesel

STANDARD OIL COMPANY OF CALIFORNIA

SOLVING *the*

Small Job Problem

THE SMALL bituminous job now offers new profits to the contractor — and real savings to the Engineer.

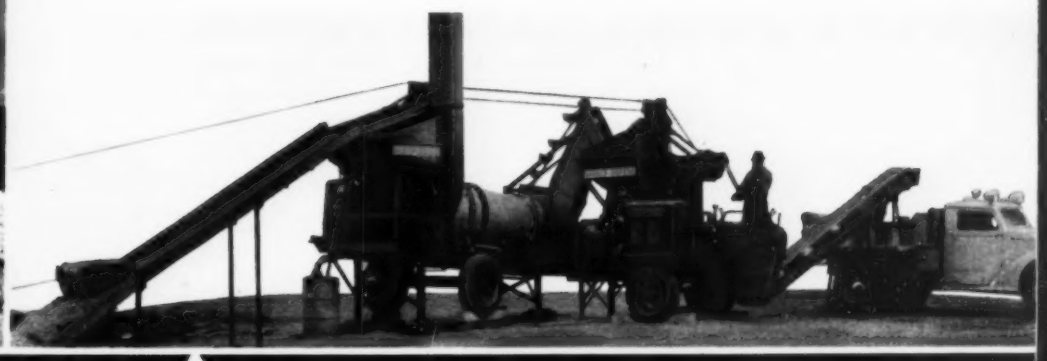
Barber-Greene announces the Maintenance Plant *designed for the small job.*

For the first time, the small job can be done *correctly* and *profitably.*

The B-G Maintenance Plant is built for those 3 or 4 block jobs, for short resurfacing stretches, for alleys, patching, and the other innumerable small tonnage jobs that have been inadequately done or have cost too much. It is complete. With the working materials ready, all you need is the trucks to haul away the finished mix.

The Portability, Flexibility, and High Capacity of this new Barber-Greene are outstanding achievements in machine design.

A folder giving the many interesting facts is yours without obligation.



BARBER GREENE

STANDARDIZED MATERIAL HANDLING MACHINES

AURORA ILLINOIS

All WORLDS RECORDS for SPEED have again been exceeded at the Carlton Drainage Tunnel with EIMCO-FINLAY LOADERS

Four rounds have been drilled, blasted, and loaded in one 8-hour period; the average, however, is between three and four. Average time spent in drilling in an 8-hour shift is 4 hours and 20 minutes, which includes moving in the jumbo, drilling, removing the jumbo, and blasting. The time required for the individual operations is as follows: moving in the jumbo and setting up, 10 minutes; drilling a round, 50 minutes; removing jumbo, 5 minutes; loading and blasting, 15 minutes; total 80 minutes. The average time spent in mucking during an 8-hour shift is 3 hours and 40 minutes, which includes moving in loader, loading, and removing loader. Moving in the loader requires 10 minutes, mucking a round 50 minutes, and removing the loader 5 minutes—a total of 65 minutes.

An Eimco 21 loader is used, mucking into Granby-type cars of 84 cu.ft. capacity. The cars are shifted behind

Reproduced from 3-page article entitled "Deeper Drainage for Cripple Creek District" in Dec. 1939 issue of Engineering & Mining Journal. We'll be glad to send you a reprint of the complete article.

1879 ft. advance in 31 consecutive days from March 10th, 1940 to April 9th inclusive .... 74 ft. in 24 hrs. on April 6th ... 13235 ft. total advance in the 8 months ending April 21st.

OUR ADVERTISEMENT in the April issue of Construction Methods gave figures regarding footage attained in driving the 32,000 ft. Carlton Drainage Tunnel (near Cripple Creek, Colorado) which exceeded all previous known achievements, but since then Supt. John Austin and his crew of veteran tunnel men have set new world's records which may easily stand for many years to come. Enlargement of the tunnel section to 10 ft. in width by 11 ft. in height has permitted deeper rounds, and such efficient car changing that a complete 8 ft. round is now mucked out in from 50 to 60 minutes.

Only one Eimco-Finlay Loader is used at a time, as here illustrated, and the 90-95 cu. ft. cars (with flashboards) are filled in less than three minutes. Air consumption is about the same as for a "drifter" drilling machine, the loader being connected to the main air line by a 50-ft. length of 1¼" hose. Maintenance cost, up to date, has been only about one-fourth of what had been allowed for by the management on the basis of previous experience with electrically-operated mucking machines.

Complete information regarding the design, construction and operation of Eimco-Finlay Loaders and the results obtained through their use on several tunnels now being driven in different parts of the United States, furnished promptly on request.

THE EIMCO CORPORATION, Salt Lake City, Utah, U.S.A.

NEW YORK	CHICAGO	EL PASO	SACRAMENTO
330 W. 42 St.	333 No. Michigan Ave.	Mills Bldg.	1217 7th St.

Sales Representatives in all principal countries throughout the mining world

Eliminates 80% of DRILLING *and* SHOOTING *with* LeTOURNEAU ROOTER

MAKING SCRAPER DIRT out of the shale rock and decomposed granite on the Golden Gate Turf Club's 1,200,000-yard track construction at Albany, Calif. The K-30 Rooter has plenty of strength to take the pulling and pushing power necessary for shattering such tough rocky material as this. After Rooting, three LeTourneau Carryall Scrapers and two Angledozers handled all excavation and placement.

New, stronger K-30 Rooter "...*dynamite on wheels...*" says Jack Casson.

"We gave it the works," Contractor Casson continues, "but in spite of the tough going . . . and the combined power of *two* D8 'Cats' . . . we couldn't find a weak spot in this new LeTourneau K-30 Rooter. It shattered tough granite and shale . . . rooted out boulders weighing at least two tons . . . and eliminated 80% of our drilling and shooting. *It's the best tool of its kind we've ever seen.*"

You can shatter tough, rocky material . . . make profitable scraper dirt of it . . . just as alert Contractor Casson did . . . by using LeTourneau heavy duty Rooters. The new K-30 is built especially for tough jobs—12,250 pounds (all structural steel — no steel punchings) of "toothed dynamite" with heavy, 3-inch shanks strong enough to take the power of 2 pulling tractors and a pusher. Try it on your toughest section... see for yourself how the K-30 can cut you into extra profits. Call your LeTourneau - "Caterpillar" dealer . . . NOW . . . ask him to show you on your own job. R. G. LeTOURNEAU, INC., Peoria, Ill., Stockton, Calif.

Check These Money-Saving K-30 Rooter Features

✓ **MORE WEIGHT** . . . 12,250 pounds . . . adds to the instant penetration of the ***plow-like*** digging design . . . and holds the Rooter in the ground with a ***natural*** suction.

✓ **EXTRA STRENGTH** . . . 1-inch steel plate construction—electric arc-welded throughout . . . every ounce of LeTourneau Rooter weight is ***structural*** strength.

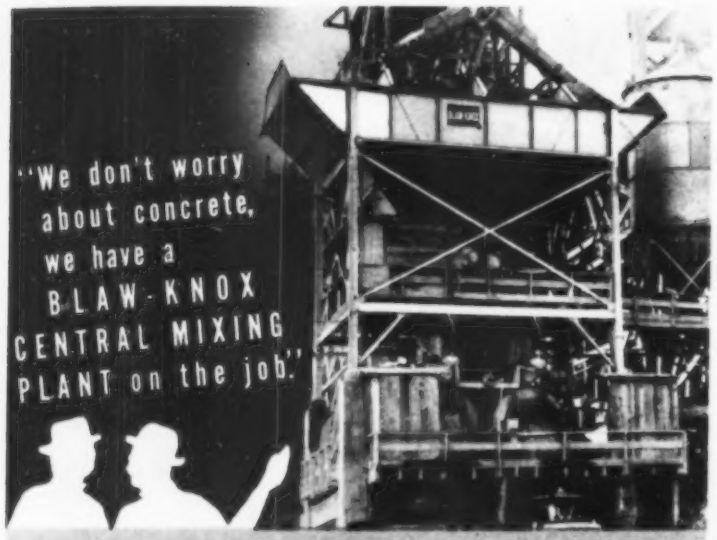
✓ **BIGGER SHANKS** of 3-inch heat-treated alloy steel . . . matches added strength with deeper penetration (up to 30 inches).

✓ **TOUGHER DIGGING TIPS** of heat-treated die steel . . . ***reversible*** for extra service . . . easily ***replaceable*** after long life.

LETOURNEAU

CARRYALL* SCRAPERS, ANGLEDOZERS*, BULLDOZERS, ROOTERS*, POWER CONTROL UNITS, DRAG SCRAPERS, PUSHDOZERS, SHEEP'S FOOT ROLLERS, BUGGIES*, CRANES, TREEDOZERS.

*Name Reg. U. S. Pat. Off.



Engineering advice, based on sound experience, is offered as a part of Blaw-Knox service in the design and arrangement of a central mixing plant for your job.

Stationary or floating plants, manual or automatic in operation, have been furnished on hundreds of jobs. Many of them are illustrated in Blaw-Knox Catalog No. 1566.

BLAW-KNOX DIVISION of Blaw-Knox Company
FARMER'S BANK BUILDING PITTSBURGH, PA.
Offices and Representatives in Principal Cities

12

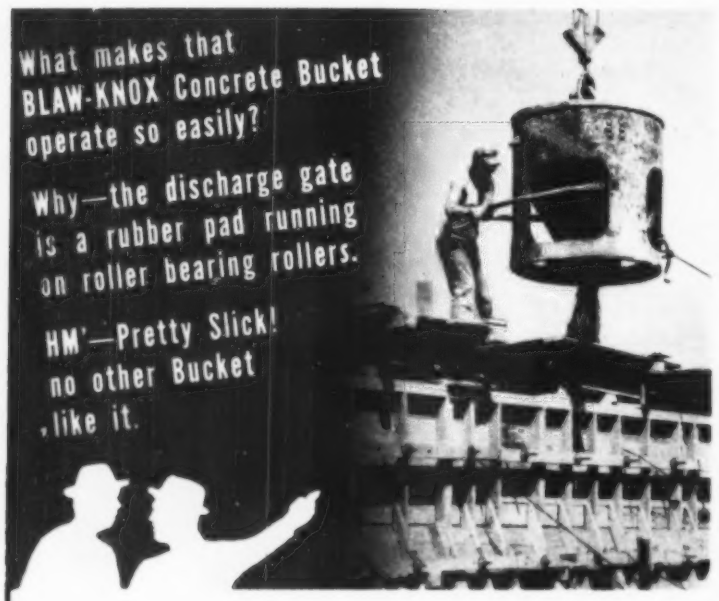
BLAW-KNOX
Central Mixing Plants

Blaw-Knox BULK CEMENT PLANTS are the ultimate in portability, speed, and convenience of use and operation. They are *complete units* for unloading, storage, batching and handling of bulk cement—dependable and accurate.

Completely described in Blaw-Knox Catalog No. 1566. Send for copy

21

BLAW-KNOX BLAW-KNOX DIVISION OF BLAW-KNOX CO. Farmers Bank Bldg. Pittsburgh, Pa.
Bulk Cement Plants

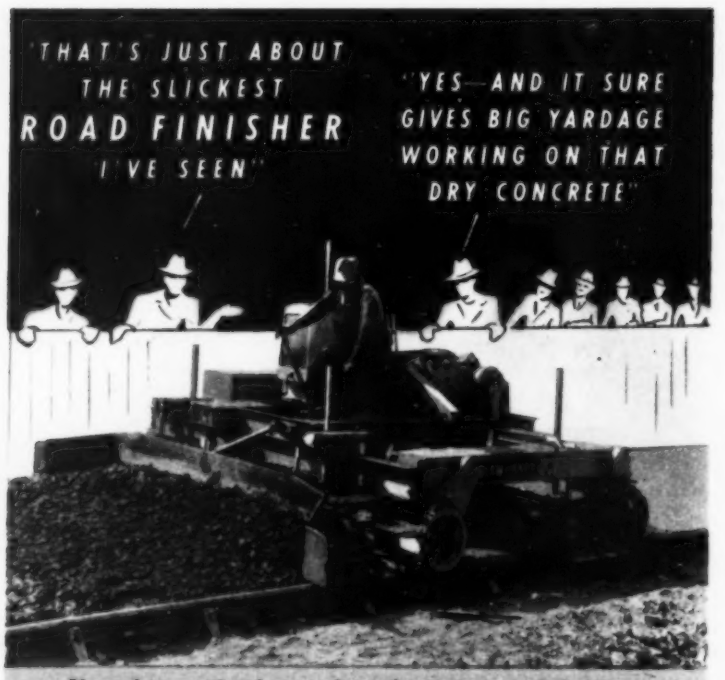

What makes that BLAW-KNOX Concrete Bucket operate so easily?
Why—the discharge gate is a rubber pad running on roller bearing rollers.
HM'—Pretty Slick! no other Bucket like it.

• Controllable discharge, Blaw-Knox CONCRETE BUCKETS are a popular concrete placing unit. Used by contractors everywhere.

Send for a copy of the catalog on Blaw-Knox Concrete Buckets, No. 1586

BLAW-KNOX DIVISION of Blaw-Knox Company
FARMERS BANK BUILDING · PITTSBURGH, PA.

BLAW-KNOX *Roller Gate*
CONCRETE BUCKETS



If you're on the fence about buying a road finishing machine this season it will definitely pay you to get full information about this *new* Blaw-Knox ROAD FINISHER.

You can depend upon this machine to maintain maximum job production schedules—even when working in dry concrete.

Ask about the ten exclusive features of the Blaw-Knox Road Finisher which make for better and faster paving. See it before buying.

37

BLAW-KNOX BLAW-KNOX DIVISION OF BLAW-KNOX CO. FARMERS BANK BUILDING PITTSBURGH, PA.
ROAD FINISHERS

A SHOVEL WITH 8 Points IN ITS FAVOR!

RELIABILITY—56 years of constant improvement

EFFICIENCY—No lost motion or wasted power

DURABILITY—High grade steel construction plus Marion-made special castings and forgings

VERSATILITY—May be fitted as shovel, clamshell, dragline or crane

SPEED—More yards per hour . . . jobs finished on schedule

ECONOMY—Low cost operation . . . low, profitable bids

MOBILITY—Finger-tip control spots loads accurately . . . handles big yardage quickly

STABILITY—Well balanced under load . . . resists sudden stress and strain

●

Marions are breaking performance records everywhere . . . they combine extra yardage with minimum expense . . . get jobs done on time. ● Decide on a Marion. Our engineers will be glad to help you select the proper model.

The MARION STEAM SHOVEL CO.
MARION, OHIO, U. S. A.

AWARD FOR SERVICE AND PROVEN PERFORMANCE

MODERNIZE with

MARION

SHOVELS • CRANES
DRAGLINES • CLAMSHELLS • PULL-SHOVELS • WALKERS

From ⅜ cu. yd. to 35 cu. yds.
GASOLINE - DIESEL - ELECTRIC

They cut themselves

WHEN the growing pure-water demands of south-side Chicago led to the planning of a new seven-million-dollar filtration plant, finding a suitable site was one of the big problems. "Plenty of room in Lake Michigan," said some one. And it wasn't a wise-crack, either! . . . for with modern vision, engineering and "Caterpillar" Diesel equipment, practical projects are achievable today which a few years ago would have been impossible—or prohibitive in cost at least.

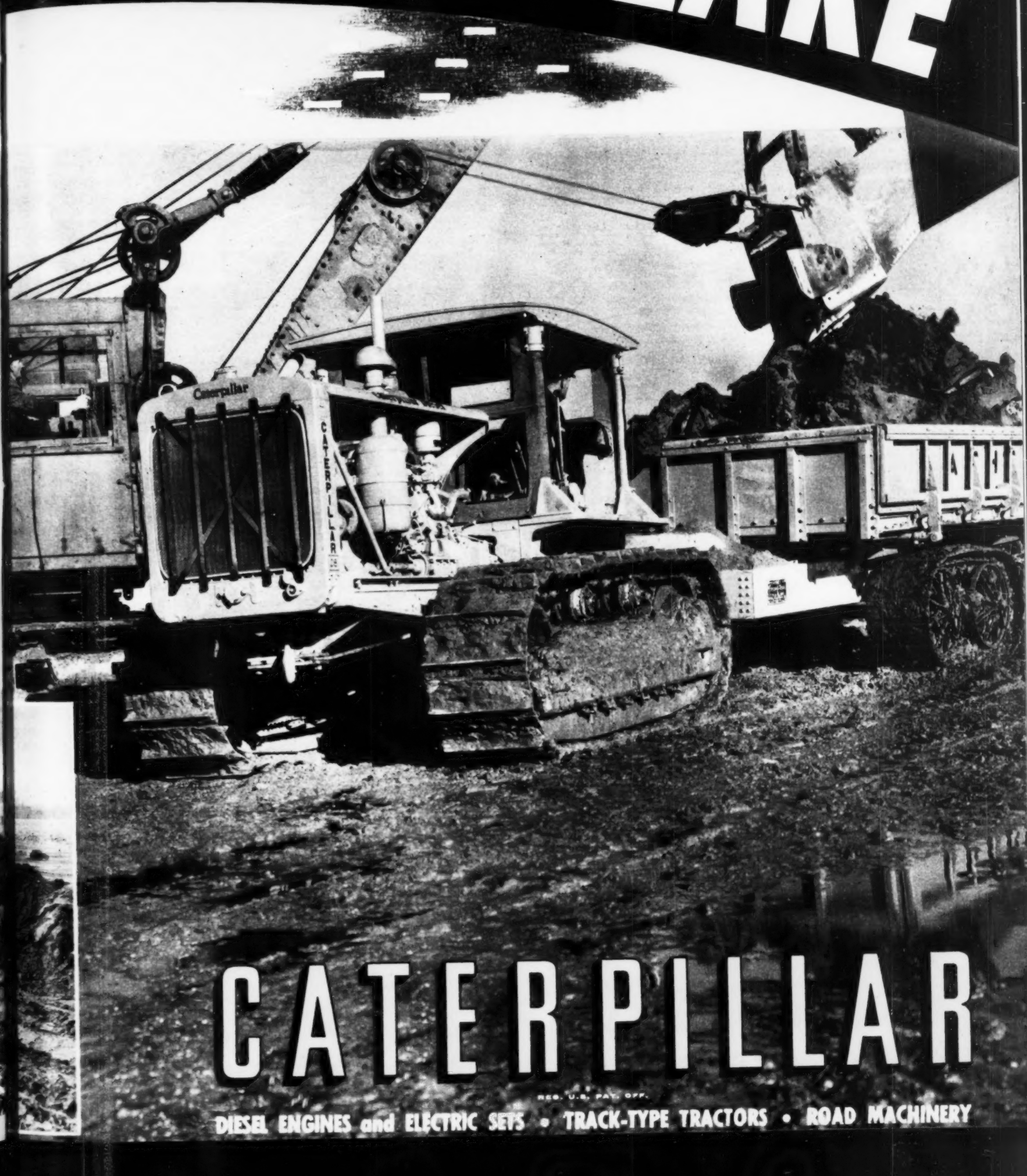
A rock-and-steel coffer-dam blocked out a 1000 by 1600-foot "slice" of the Lake. With the water pumped out and unlocking the secrets of a million-year-old lake bottom, excavating difficulties were expected—and found. Deep mud and wet packed-down clay . . . low-level sand boils and springs . . . steep grades and slithery footing . . . frigid winter sprays sheathing equipment in ice . . . these were some of the difficulties M. Pontarelli & Sons, contractor, encountered in removing 450,000 yards and hauling it as much as a quarter of a mile.

But they knew the equipment that could "take it." With powerful, light-treading, yet sure-gripping "Caterpillar" Diesel Tractors and side-dumping Athey wagons they licked the hauling problems. With "Caterpillar" Diesel Tractors and bulldozers, excavating went on at a quick pace. With "Caterpillar" ruggedness and stamina, operations continued relentlessly throughout the winter, with minimum time out for equipment maintenance and servicing. With "Caterpillar" Diesel fuel economy and engine efficiency, low operating costs contributed neatly to the profit margin.

"It takes 'Caterpillar' Diesel equipment to lick the tough jobs and beat the time limits," has long ago become a byword among successful contractors. And the fact that "Caterpillar" Diesel Tractors and Motor Graders are just as tough as the jobs they're put up against, makes it reasonable to assume that they're doubly efficient and dependable on "ordinary" contract work.

CATERPILLAR TRACTOR CO., PEORIA, ILL.

a piece of LAKE



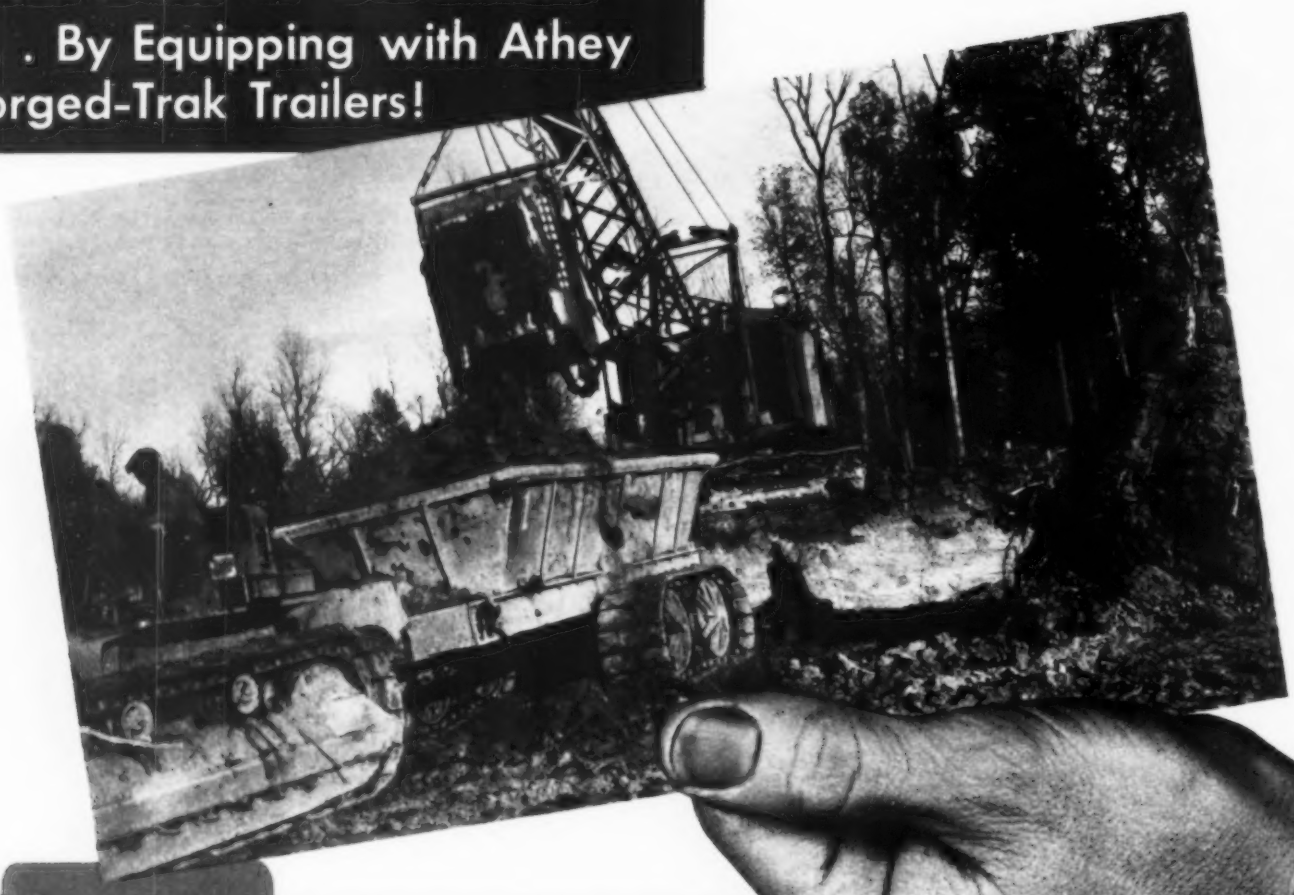
CATERPILLAR

REG. U.S. PAT. OFF.

DIESEL ENGINES and ELECTRIC SETS • TRACK-TYPE TRACTORS • ROAD MACHINERY

THEY STOPPED TROUBLE BEFORE IT STARTED

. . . By Equipping with Athey Forged-Trak Trailers!



JOB: Levee construction job near Driver, Ark.

CONTRACTOR: Lowrance Bros. & Co.

EQUIPMENT: 3 D8 "Caterpillar" Diesel Tractors
3 18-Yard Athey Forged-Trak Bottom Dump Trailers

In July, 1938, we purchased one D8 tractor and one F-18 Athey Forged-Trak Bottom Dump Trailer for levee construction on the White River. We used this in a fleet of hauling units consisting of two 12-yard rubber-tired, self-powered units, and one tractor and 18-yard track-type trailer.

"About August, 1939, we moved on a job where we knew traction conditions would not be as favorable as they had been on our last job. From our past experience of the ability of the tractor trailer to operate more efficiently on this type of ground condition, we purchased two more D8's and Athey Forged-Trak 18-Yard Trailers.

"To date we have about 5000 hours on our first unit, which is by far more life than we have obtained from any other track-type trailer."

MOTORIZE

Motor trucks can operate efficiently on smooth roadways—that's why the army uses motor trucks to speed men and ammunition close to the scene of battle quickly.

MECHANIZE

But for the actual attack—on the battlefield—the army is mechanized with tanks. Motorize AND mechanize to beat hauling hazards and limitations.

—Just another of the many contractors who have convinced themselves that large capacity trailers mounted on today's Athey Forged-Traks, pulled by "Caterpillar" Diesel Tractors, are the answer for maximum loader production—in shorter time—regardless of varying conditions. Here is equipment that furnished its own roadway over slippery clay and mud—that cuts loading time by getting right up to the dipper. For further proof, and for full operating data—see your "Caterpillar" dealer or write.

ATHEY
TRUSS WHEEL CO.

5631 West 65th Street, Chicago, Illinois
Cable Address: *"Trusswheel", Chicago*

ATHEY FORGED-TRAK WAGONS AND TRAILERS

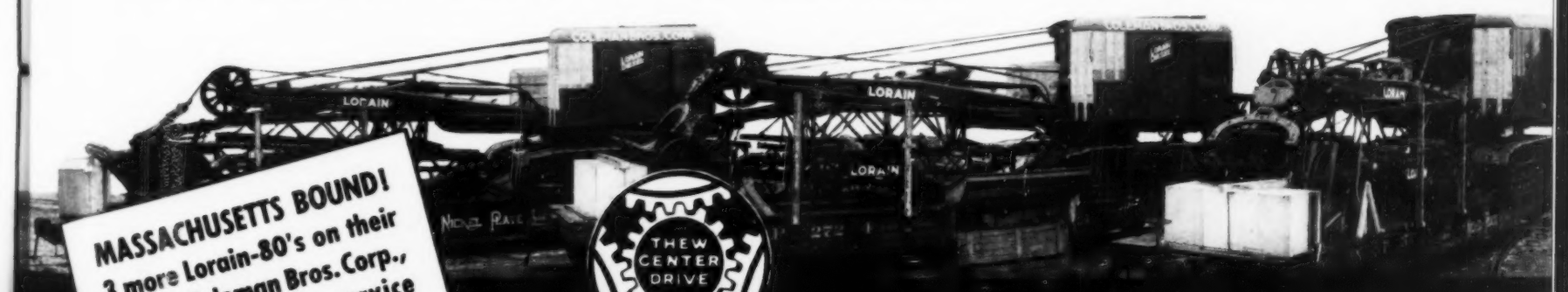
THE "80" WAS WEANED ON STUFF LIKE THIS

● Lorain-80's have been on the spot since birth—and probably always will be because their owners reserve their toughest jobs for them. First of these 1¾-yd. units appeared on the rock sections of the Pennsylvania Turnpike. Others have since gone to work in Manhattan rock—on 24-hour coal stripping operations—and scores of other equally tough assignments that really test a shovel's mettle.

When you study the Lorain-80's construction, the reasons for its outstanding performance are obvious. The burly, all-welded steel shovel boom has "strength" written all over it. Double Center Drive design of turntable brings engine power out of hiding, applying it directly where and when you want it. And the big Center "Chain" Drive crawler carts this heavy duty unit cross-country or in and out of tight spots with unbelievable ease and speed.

If you want a 1¾-yd. shovel that's new in design and construction yet thoroughly proved from the standpoint of performance, the "80" will fill the bill. Write today for illustrated catalog.

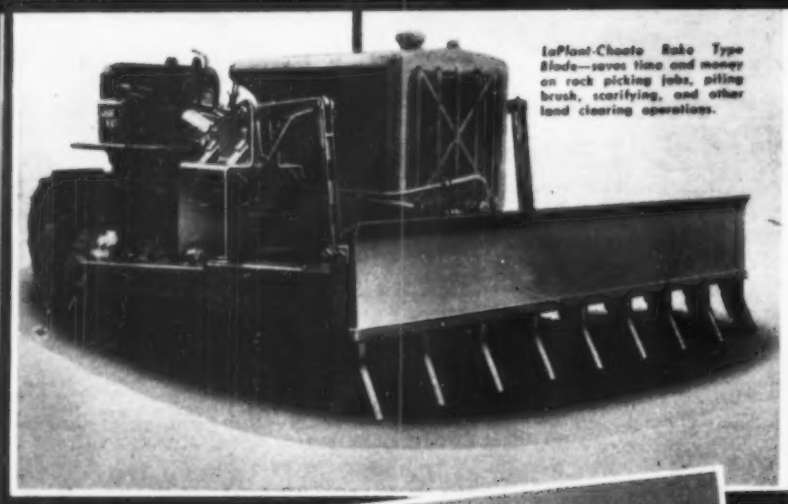
THE THEW SHOVEL COMPANY • LORAIN • OHIO



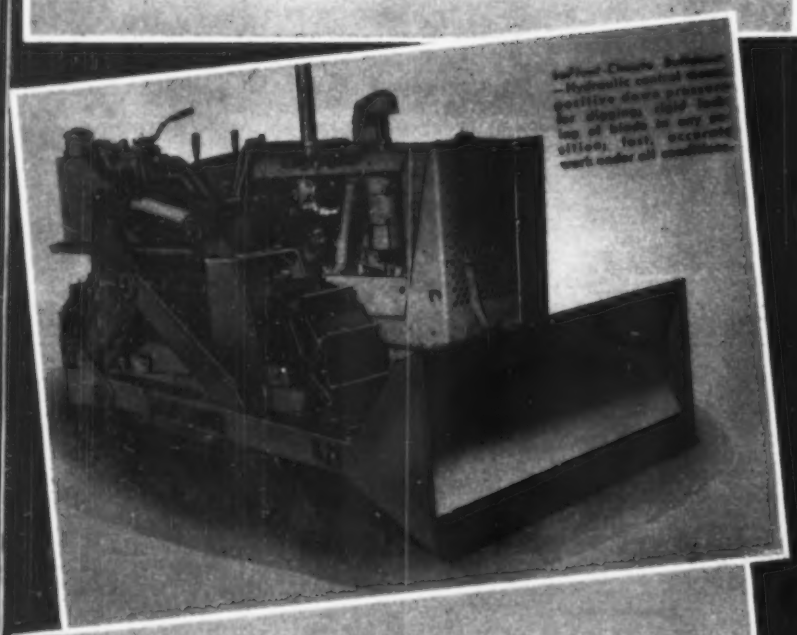
MASSACHUSETTS BOUND!
3 more Lorain-80's on their way to Coleman Bros. Corp., Boston, Mass. for service on Franklin Dam.

THEW CENTER DRIVE
REG. U.S. PAT. OFF.

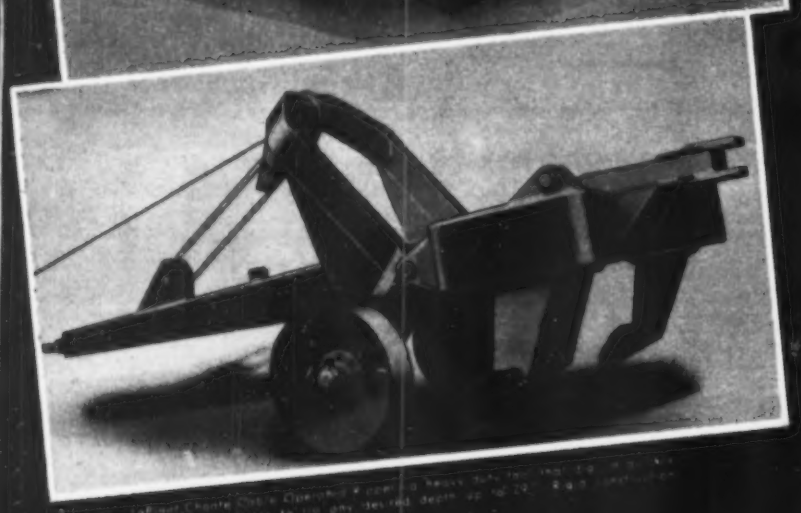
1¾ YD. LORAIN-80



LaPlant-Choate Rake Type Blade—saves time and money on rock picking jobs, piling brush, scarifying, and other land clearing operations.



LaPlant-Choate Bulldozer—Hydraulic control assures positive down pressure for digging right from top of bank to any position, fast, accurate work under all conditions.

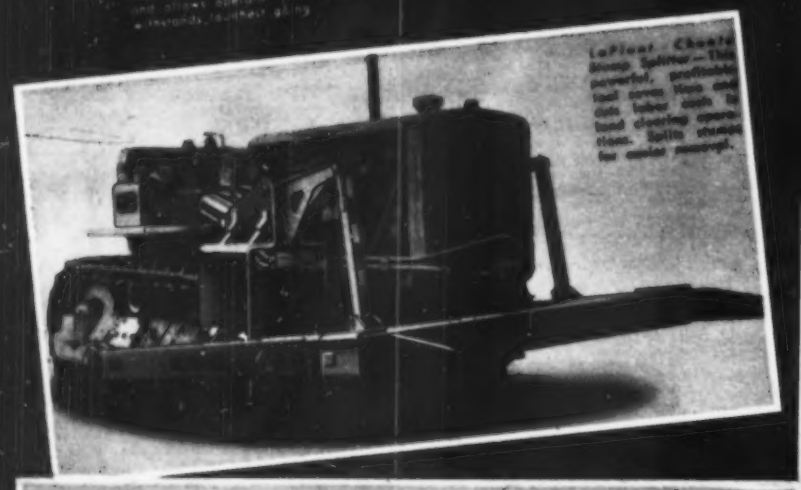


LaPlant-Choate Carryall Scraper—No overhead or structure. Pertorms in cramped operations here and at town dump. Loads and hauls a set load when desired.

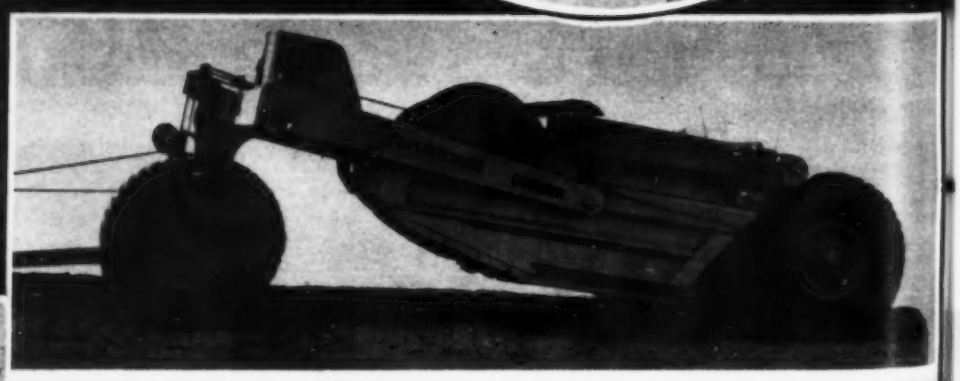
...Profitable...
...Dependable...
...Versatile...

LAPLANT-CHOATE

Earth Moving and Land Clearing Equipment



LaPlant-Choate Stump Splitter—This powerful, profitable unit cuts, lifts and piles land clearing stumps, fast. Splits stumps for easier removal.



LaPlant-Choate Tree Dozer—removes trees up to 18" in diameter, roots and all; deposits in windrow and fills stump holes in one operation.

Complete Sales and Service Facilities From

A PLANT-CHOATE and "Caterpillar"

Dealers Throughout the World.

A Complete Line from ONE SOURCE

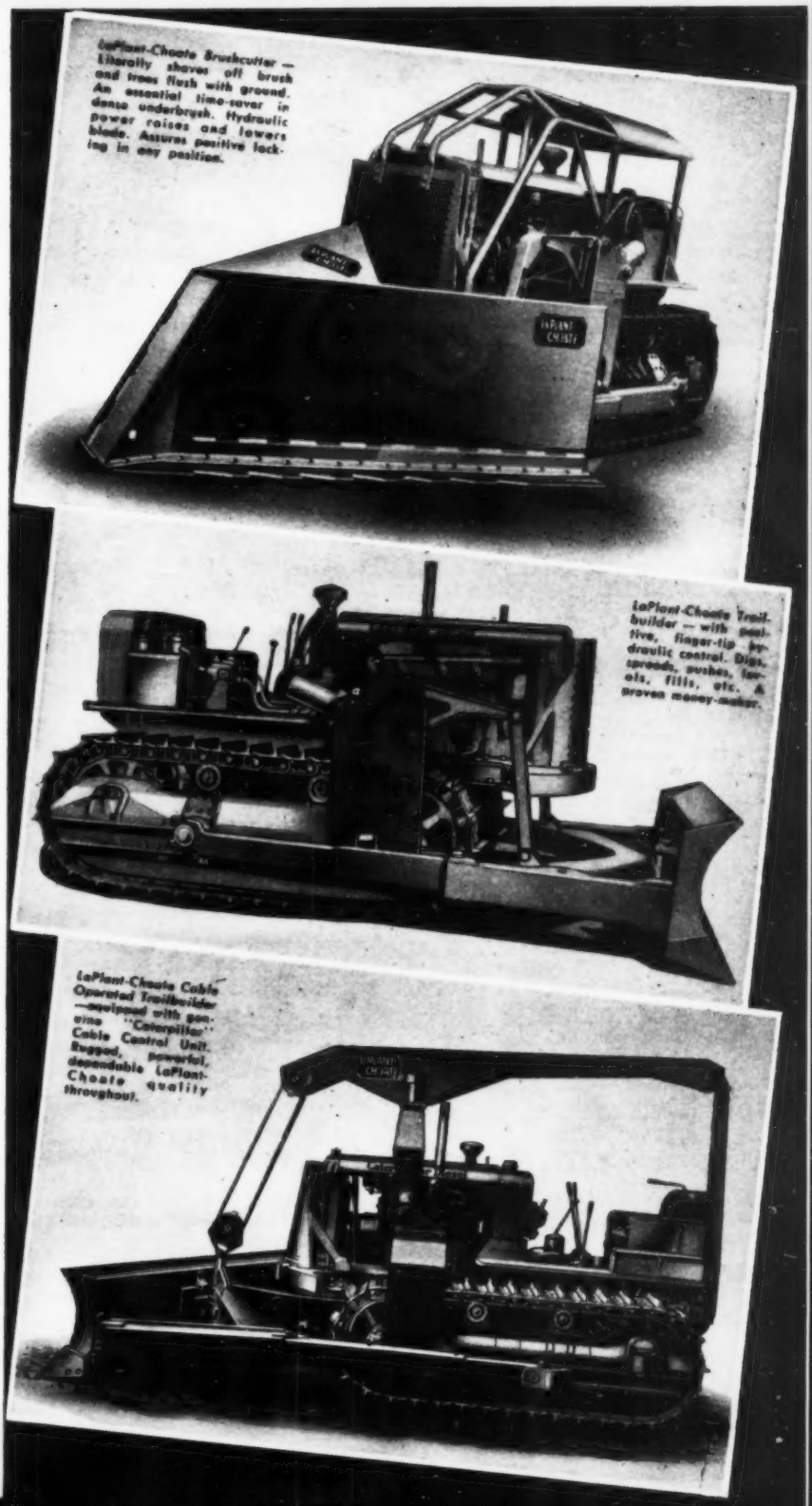
Means Better Service Better Performance Uniform Quality

Standardize your equipment — all from one line — and many performance and service problems automatically disappear. More and more successful operators are standardizing with world-famous LaPlant-Choate equipment—standardizing because every unit in this complete line has *earned* its position of leadership by actual performance.

Mechanically, every piece of LaPlant-Choate earth-moving and land-clearing equipment embodies the very finest advanced engineering features . . . features that a thorough knowledge of the field and years of experience prove *must* be there to give you extra years of profitable performance. Every new LaPlant-Choate development is given gruelling field testing before it is released to the market. Thus, improvements, if any are needed, are made *before* you take the units on your jobs.

And when all your heavy duty equipment of this type is manufactured in one place under one standard of workmanship and quality of materials, you know you can depend on it under all conditions. Parts are readily available . . . skilled service facilities are always available from the nearest LaPlant-Choate and "Caterpillar" dealer no matter to what part of the world your job may take you.

The ability to speed up production and lower costs is built into every LaPlant-Choate unit. They are all designed for use exclusively on "Caterpillar" Track-type tractors. So modernize now with the best — LaPlant-Choate. Write today for Free catalogs and full details.



LaPlant-Choate Brushcutter — Literally shaves off brush and trees flush with ground. An essential time-saver in dense underbrush. Hydraulic power raises and lowers blade. Assures positive locking in any position.

LaPlant-Choate Trail-builder — with positive, finger-tip hydraulic control. Digs, spreads, pushes, levels, fills, etc. A proven money-maker.

LaPlant-Choate Cable Operated Trailbuilder — equipped with genuine "Caterpillar" Cable Control Unit. Rugged, powerful, dependable LaPlant-Choate quality throughout.

LA PLANT-CHOATE MANUFACTURING CO. Inc.

CEDAR RAPIDS, IOWA

15 Bethlehem warehouses

will give you rapid service on Reinforcing Bars

In addition to a complete stock of reinforcing bars, each of these Bethlehem warehouses has shearing and bending equipment so that bars can be cut to length and bent to shape as required.

Whatever the location or size of your new contract, let the nearest Bethlehem warehouse give you fast efficient service on reinforcing steel.

BETHLEHEM STEEL

BETHLEHEM STEEL COMPANY

ANOTHER NORTHWEST in ROCK on the turnpike

AFTER seeing Northwests perform in rock, N. R. Corbisello, of Binghamton, N. Y. selected a Northwest Model 80 for his own rock job near Bedford, Pa., on the Turnpike.

Northwests are built for rock! That Northwest Welded Boom—*and no Northwest Welded Boom has ever failed*—those wide dipper sticks of heavy section, with the extra resistance to twisting strains given them by the cap casting which ties their upper or inner ends together—the Dual Crowd that utilizes force other shovels waste—these are Northwest features that are hard to equal in rock and with Northwest design and power make the Northwest a *Real* Rock Shovel.

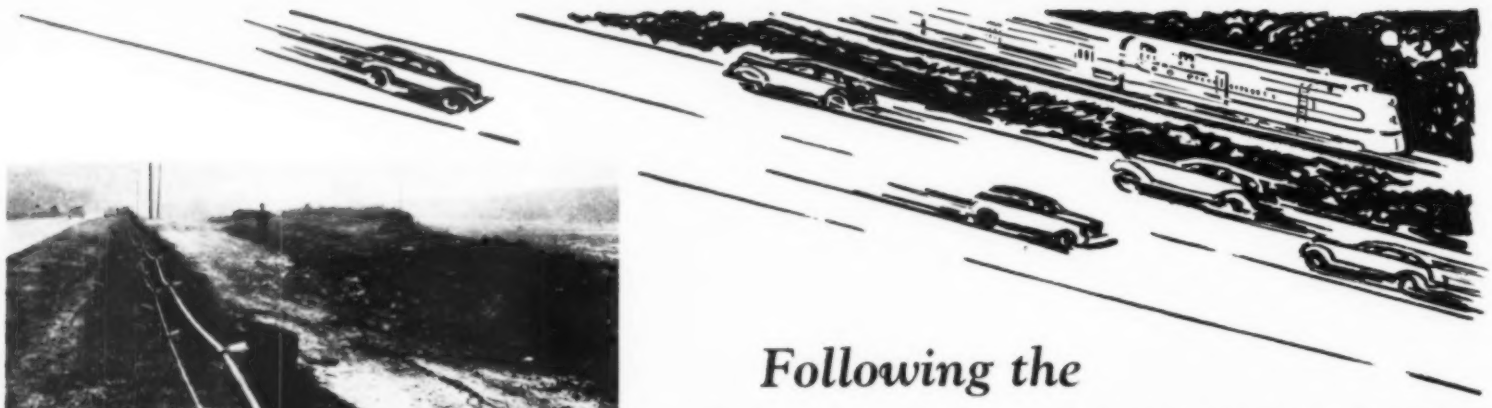
NORTHWEST ENGINEERING COMPANY
1728 Steger Bldg., 28 E. Jackson Blvd.
Chicago, Illinois

It's a real ROCK SHOVEL-

Built in a range of 18 sizes—3/8 cu. yard capacity and larger.

NORTHWEST

SHOVELS • CRANES • DRAGLINES • PULLSHOVELS • SKIMMERS



View of last section, 115 feet, just before blast October 27, 1939.

View of blast. Note proximity to main highway

View after blast, with fill settled.

Following the
"STRAIGHT *and* NARROW PATH"
(between highway and railroad)
with ATLAS
Fill Settlement Methods

IN building the new Governor Printz Boulevard near Wilmington, Del., a 650-ft. marshy section was encountered where the fill had to be settled—easy enough under ordinary circumstances. But—only 31 feet from the center of the new road ran the main highway then in use! And on the other side lay the tracks and electric towers of the Pennsylvania Railroad's main line between New York and Washington.

Here was a job that called for modern explosives, careful work, and expert control—in a word, Atlas Fill Settlement Methods.

In important construction jobs throughout the country, Atlas Explosives and Atlas Methods are daily contributing to "better blasting." Call in the Atlas Representative on your next job!

ATLAS POWDER COMPANY, WILMINGTON, DEL.

Cable Address—Atpowco

Everything for Blasting

OFFICES

Allentown, Pa.	Houghton, Mich.	New Orleans, La.	Pittsburgh, Pa.	Spokane, Wash.
Boston, Mass.	Joplin, Mo.	New York, N. Y.	Portland, Oregon	St. Louis, Mo.
Butte, Mont.	Knoxville, Tenn.	Philadelphia, Pa.	Salt Lake City, Utah	Tamaqua, Pa.
Chicago, Ill.	Los Angeles, Calif.	Picher, Okla.	San Francisco, Calif.	Wilkes-Barre, Pa.
Denver, Colo.		Pittsburg, Kansas	Seattle, Wash.	

ATLAS
EXPLOSIVES

CHEMICALS ATLAS EXPLOSIVES

"*This advanced lubrication service helped us* reduce operating costs"

. . . Say Operating Officials

GULF PERIODIC CONSULTATION SERVICE

gives you a practical cost-reducing tool you can put to work at once!

HOW to offset mounting "non-controllable costs" — that's the perplexing problem executives and operating men are facing today.

Here is a practical cost-reducing tool you can put to work in your plant that will help you cut controllable costs and offset the higher non-controllables. Through this modern lubrication service, you get the benefits of the advanced knowledge and skill which Gulf's large staff of technologists has developed during recent years. *Without one cent of additional investment,* you are assured that efficient operation of your machinery is maintained and costs for maintenance held down to a minimum.

For the operating official who is seeking a means to reduce costs and increase profits, here is something *definite* that can be done — at once! Write for your free copy of the booklet which explains this money-saving service.

SEND FOR THIS BOOKLET

GULF INDUSTRIAL LUBRICATION

Gulf Oil Corporation — Gulf Refining Company
Room 3813, Gulf Building, Pittsburgh, Pa.
Please send my copy — no charge — of the booklet "GULF PERIODIC CONSULTATION SERVICE."

Name.....

Company.....

Address.....

COMPLETE CHAIN SERVICE

ACCO makes all types of welded and weldless chain–fittings–attachments

Your chain equipment problems, whatever they be, find solution in the complete lines of American chains, fittings and attachments. Whether your jobs require our new Endweldur Chains in a modern alloy steel—or whether they are done best with good iron chain—the American line has what is right for the work in hand.

Back of every chain we make are years of patient research and development work in field and laboratory, honest and unstinted man-hours of labor in our mills, and every manufacturing safeguard we can employ.

How ACCO'S Modern Engineering and Efficient Organization HELP YOU

American Chain engineers serve you in two important ways. They provide the best chains for countless purposes—and they work with you to put the most suitable chain equipment to work in the best way. They invite you to discuss your chain problems with them.

Ample stocks of American chains, fittings and attachments are located at strategic points throughout the country to serve the distributors from whom you buy.

Send for this FREE BOOKLET

It gives all the important facts about ENDWELDUR Sling Chains. Consult us (with no obligation) on any chain problem. Address American Chain & Cable Company, Inc., Bridgeport, Connecticut.

AMERICAN CHAIN & CABLE COMPANY, Inc.

AMERICAN CHAIN DIVISION
AMERICAN CABLE DIVISION
ANDREW C. CAMPBELL DIVISION
FORD CHAIN BLOCK DIVISION
HAZARD WIRE ROPE DIVISION
MANLEY MANUFACTURING DIVISION
OWEN SILENT SPRING COMPANY, INC.
PAGE STEEL AND WIRE DIVISION
READING-PRATT & CADY DIVISION
READING STEEL CASTING DIVISION
WRIGHT MANUFACTURING DIVISION

In Canada:
DOMINION CHAIN COMPANY, LTD.
In England:
BRITISH WIRE PRODUCTS, LTD.
THE PARSONS CHAIN COMPANY, LTD.

DIESEL MORE SPEED

DUMPTOR · POWER · CAPACITY

Speed, power and capacity are the three important advantages of the new Koehring W-60 Dumptor. Again, the cost of moving dirt and rock has been reduced. Diesel power for low cost fuel, simple construction for low maintenance cost, capacity and speed for maximum yardage — all profit factors. Other equally important features are — constant mesh transmission — large pneumatic tires — oscillating steering axle — instantaneous gravity dump.

KOEHRING CO · ***Milwaukee, Wis.***

New W-60 Dumptor Bulletin mailed without cost . . . Write for it today.

Instantaneous gravity dump—load is dumped *where you want it,* over end of fill without backing or turning.

KOEHRING HEAVY DUTY

HEAVY-DUTY CONSTRUCTION EQUIPMENT

Wherever

THERE'S CONSTRUCTION THERE ARE DISTRIBUTORS NEARBY TO HELP LAYOUT AND SPEED WORK

[One of a series of advertisements sponsored by Engineering News-Record and Construction Methods to remind readers of the important role the distributor plays in the economics of construction.]

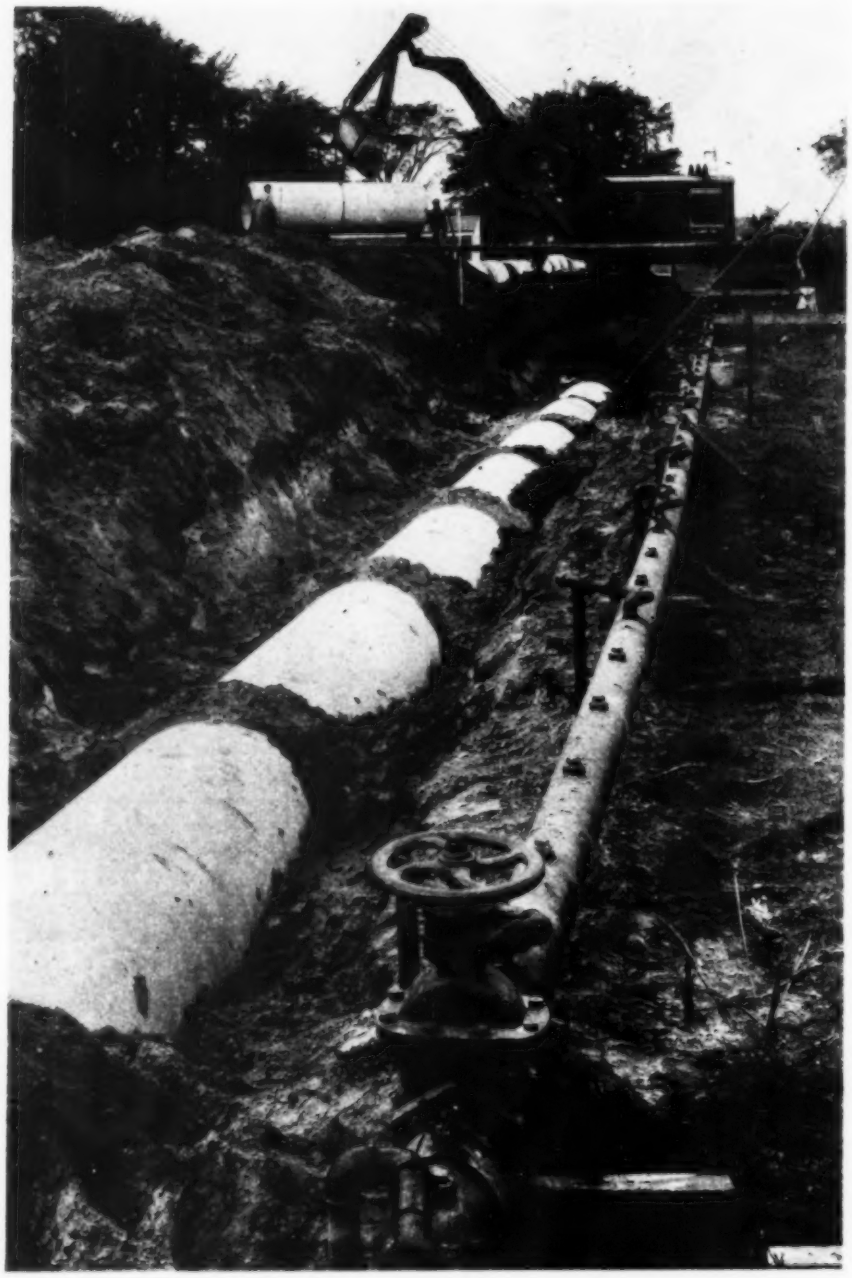
When new equipment or repair parts are needed out on the job, or supplies and materials run out, the contractor or engineer doesn't have to shut down operations waiting for his home office or some distant manufacturer to get them to him. Usually repair parts and supplies are as near at hand as a local telephone call. Everywhere about the country, wherever construction jobs may break, there are distributors with adequate inventories to meet emergency or routine requirements. Also to help plan the job and contractor's plant.

For example . . .

the Grand Rapids Water Line

Here the contractors are laying 31 miles of 46-in. steel and concrete pipe to bring Lake Michigan water to the furniture city.

In the city of Grand Rapids and in nearby Kalamazoo, Lansing, Battle Creek and Muskegon these construction men can call on more than a dozen distributors for equipment,



parts, materials and supplies to speed up the construction calendar. All they have to do is consult the classified telephone book and name their wants.

These Western Michigan distributors serve more than their chosen or assigned territories; they serve *construction men located anywhere in the United States* who may be awarded contracts in this section of Michigan. Because of the vast distributor organization through which manufacturers sell, contractors can bid on jobs anywhere in the country confident that supply sources are close at hand.

[*Have you ever given the distributor the opportunity to open up and show you what he can do to solve your problems and speed up the job? Next time you get a contract try him out. He's listed in his classified telephone book under "contractor's equipment".*]

Quicker Curing Concrete Cuts Costs

CUT CONCRETE COSTS $1.00 PER CU. YD.

VIRGINIA STATE HIGHWAY BRIDGE NEAR CULPEPPER, VA. *Contractors:* Blackwell Eng. & Cons. Co., Warrenton, Va. Quick curing in cool weather cut form stripping time to 3 days, reduced form sets required for 10—40 ft. spans from 8 or 10 to 2, and speeded completion by 16 days. Including labor and overhead, this cut concrete costs $1.00 per yd. In addition overhead costs were $300 less.

QUICK WINTER CURING—$2000 LOWER COST

POLK COUNTY GARAGE & OFFICE BLDG., BALSAM LAKE, WIS. *Architect:* E. F. Klingler, Amery, Wis. *Contractor:* James Johnson, Amery, Wis. Temperatures from −20° F. to 20° F. Quick curing with minimum heat protection allowed form stripping in 3 days to cut form costs in half—$500. Heat-curing costs were less by $600. Quicker completion saved $900, 60 days' salary for two supervisors.

$1000 LOWER COST—4 WEEKS' LESS TIME

HIGH SCHOOL ADDITION, JACKSON, MINN. *Architect:* Pass & Rockey, Mankato Minn. *Engineer:* Rose & Harris, St. Paul, Minn. *Contractors:* McGough Bros., St. Paul Minn. Quick curing concrete in floor slabs and other key portions permitted form stripping and re-use in 3 to 7 days, and cut four weeks from construction time. This cut form costs by $800, and overhead by $200.

$1800 SAVED BY QUICK SERVICE CONCRETE

SURGE TANK FOUNDATION, MILTON, VT. *Owner:* Public Electric Light Co., St. Albans, Vt., and Boston, Mass. *Engineer:* Chas. T. Main Co., Boston, Mass. *Contractor:* P. E. Sullivan, St. Albans, Vt. While building foundation, water-wheel shutdown required spending $600 per day for power. Quick curing concrete allowed waterwheel to resume power production in 48 hours instead of 5 days. This saved $1800—the cost of buying power for 3 days.

IN 24 to 48 hours Lehigh Early Strength Cement equals the strength of normal cement at 7 days. This quicker curing cuts costs, has other big advantages.

- **Reduces form costs by quick removal and re-use.**
- **Heat-protection cost in cold weather is less by one-half to two-thirds.**
- **Reduces time waiting for concrete to harden. Service strength three to five times faster.**
- **Quick use of concrete helps coordinate schedules for practically continuous operation, shortens construction time, reduces overhead expense.**
- **Helps make up delays to avoid penalty, sometimes earns bonus for earlier completion.**
- **Produces better, denser concrete.**

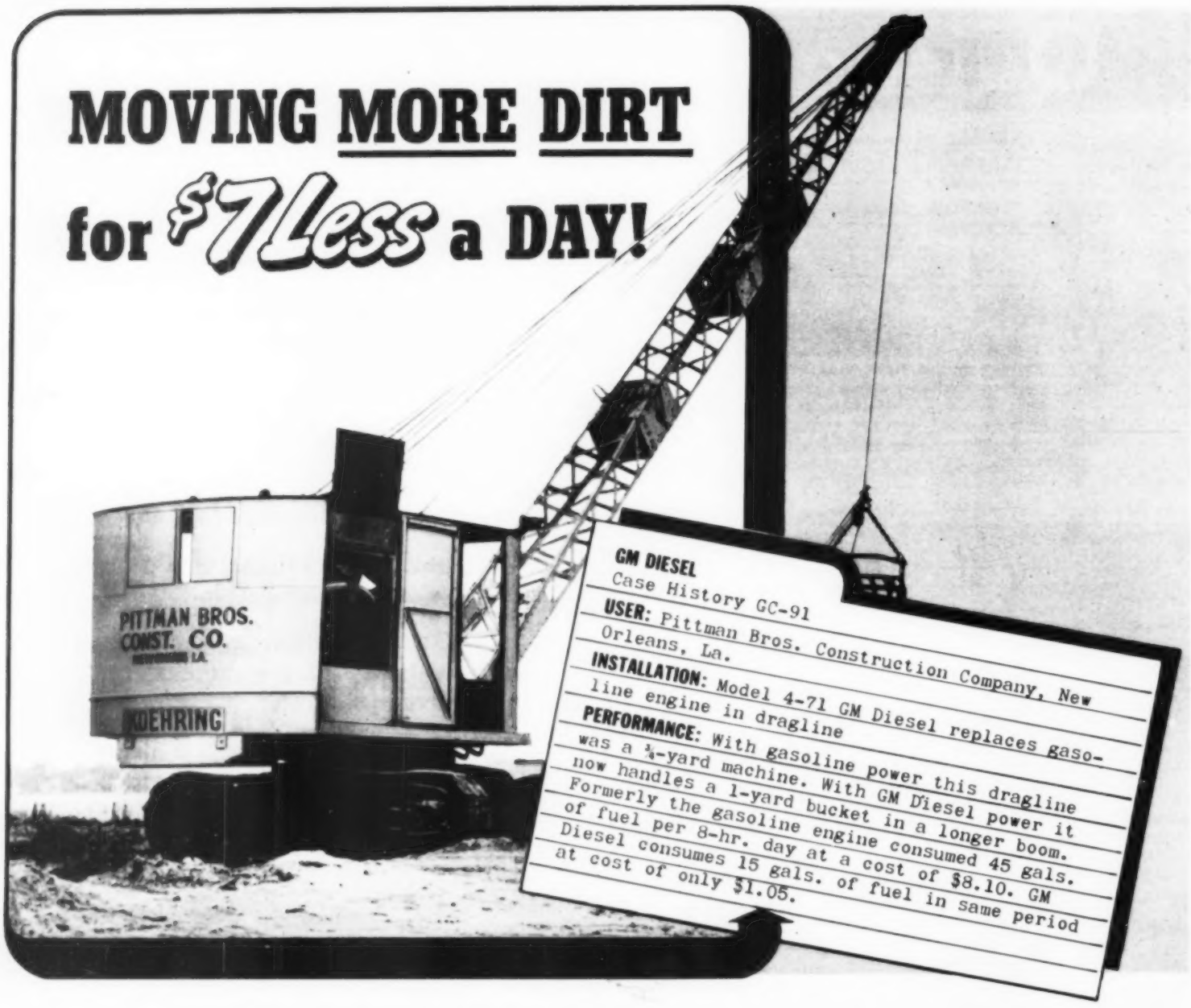
The illustrations are typical of everyday cases where Lehigh Early Strength Cement cuts costs. Use it for any concrete when time saving reduces costs, or when quicker completion is of advantage.

LEHIGH EARLY STRENGTH CEMENT

LEHIGH PORTLAND CEMENT COMPANY

Allentown, Pa., Chicago, Ill., Spokane, Wash.

MOVING MORE DIRT for $7 Less a DAY!



GM DIESEL
Case History GC-91

USER: Pittman Bros. Construction Company, New Orleans, La.

INSTALLATION: Model 4-71 GM Diesel replaces gasoline engine in dragline

PERFORMANCE: With gasoline power this dragline was a ¾-yard machine. With GM Diesel power it now handles a 1-yard bucket in a longer boom. Formerly the gasoline engine consumed 45 gals. of fuel per 8-hr. day at a cost of $8.10. GM Diesel consumes 15 gals. of fuel in same period at cost of only $1.05.

WHEN you move more dirt per hour, that's one way to make more money per job. To cut operating costs is another.

It used to be rare when you could do both at once. But not since the GM Diesel came to the aid of contractors!

GENERAL MOTORS DIESEL

And here's a typical case in point.

With its original gasoline engine, that dragline in the picture was a ¾-yard machine with a ¾-yard bucket on a 40-foot boom. Now that it's GM Diesel-powered, it has a 1¼-yard capacity with a 40-foot boom—or handles a 1-yard bucket on a 50-foot boom.

That's what we mean by moving more dirt. And this is how it does it for $7 less a day. The GM Diesel uses 30 fewer gallons of fuel per day—and, of course, a much cheaper fuel at that.

So you can see how *doubly* advantageous it was for Pittman Brothers to make the GM Diesel replacement they did.

But most important are the reasons why this Diesel can do a similar job for you in almost any sort of engineering or construction work—in portable, mobile and stationary applications of every sort.

GM DIESEL POWER

The General Motors 2-cycle principle on which it's designed enables it to lug like a steam engine—yet respond to varying loads more quickly than even gasoline engines can. Hence, the ability to make more trips—move more dirt. Likewise, its simplicity and the interchangeability of its parts make it easier to service and maintain—a most important feature on isolated, out-of-the-way jobs.

Here are certainly a host of reasons for specifying GM Diesel power in any new equipment you may have in mind.

And if you'd like to know exactly how it can better performance and lower costs in any of your present rigs, just ask your nearby GM Diesel dealer for all the facts you need—or write:

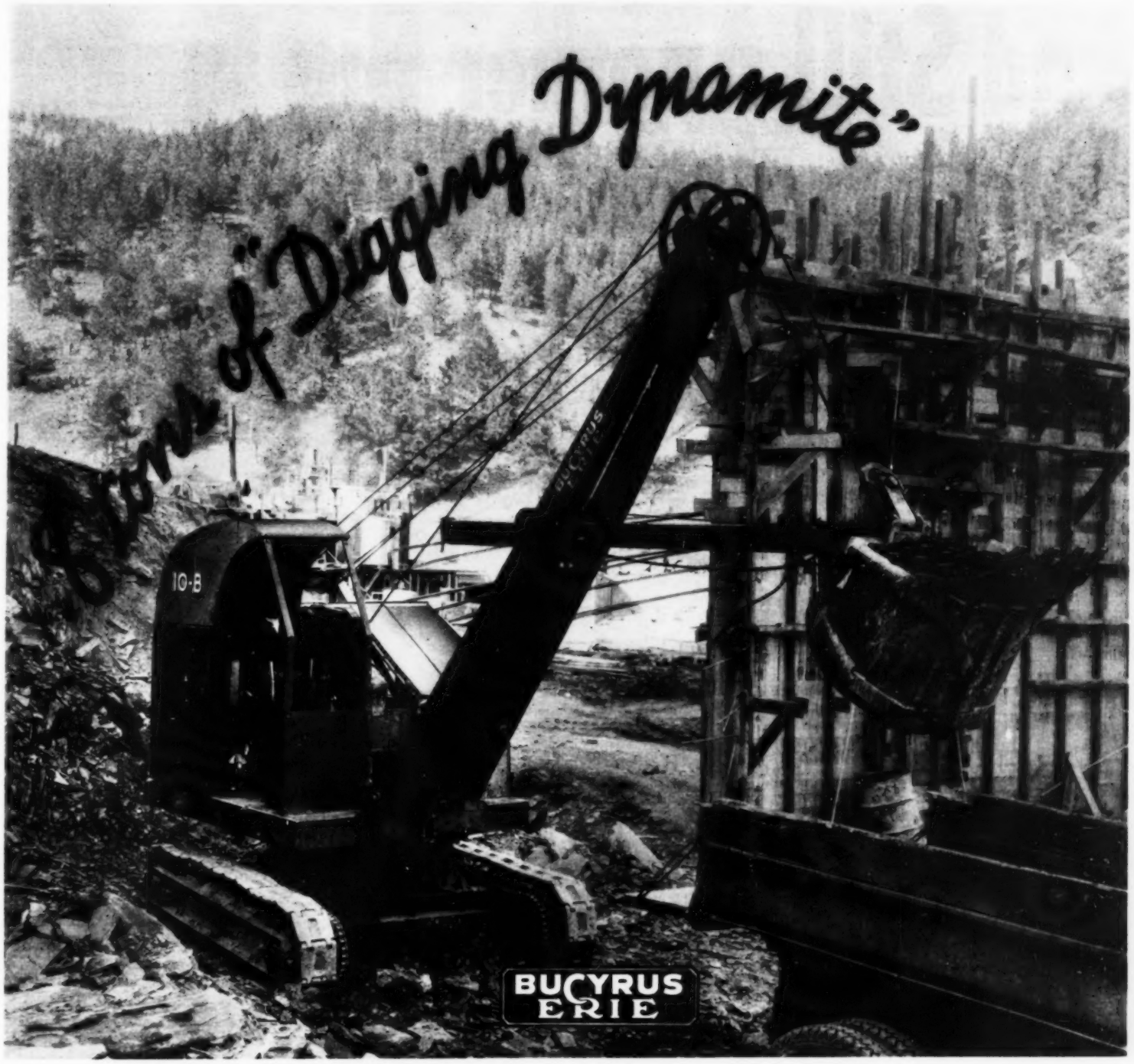
Dept. I-5-F

DIESEL ENGINE DIVISION

General Motors Sales Corporation

Cleveland, Ohio

SEE THE DIESEL EXHIBIT AT THE GENERAL MOTORS BUILDING IN THE 1940 NEW YORK WORLD'S FAIR



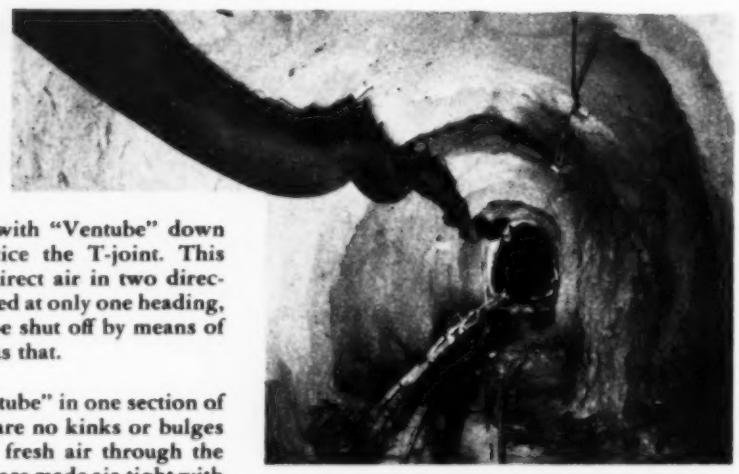
The 3/8 yard 10-B weighs only 8 tons but it can outwork many machines twice its size. For building and maintaining roads, digging drainage ditches, basement excavation, handling clean-up work, or loading, you will find the 10-B's unmatched digging speed and mobility will save you time and money. Its speed is backed by tough, modern construction that stands up to hard going day in and day out. Write for details on the savings you can make with this bit of "digging dynamite."

Bucyrus · Erie

SOUTH MILWAUKEE, WISCONSIN

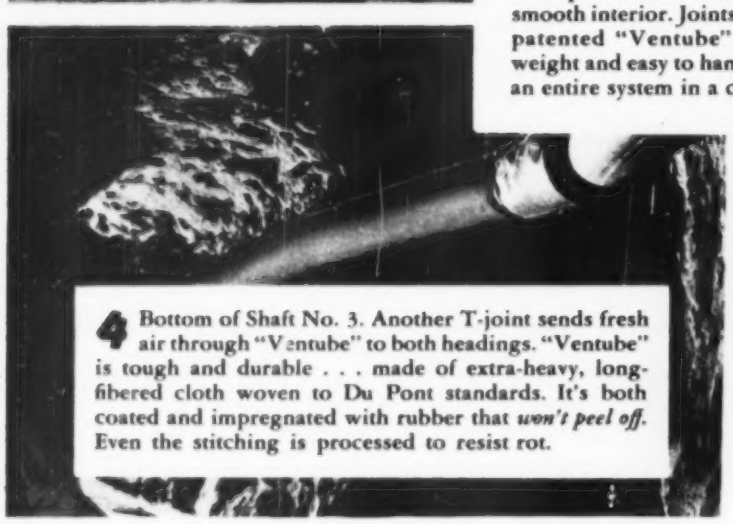
And Still Another Big Tunnel Job Completed With the Aid of VENTUBE*

1 The Duluth Sewer Tunnel has just been completed by contractors Rhude-Fryberger, Ampers and MacDonell. "Ventube" rubberized ventilating duct played an important part in its construction . . . so let's follow "Ventube" through this 5 x 7 foot tunnel, some 10,000 feet long. First, here's the motor-driven fan that sends pure, fresh air through "Ventube."

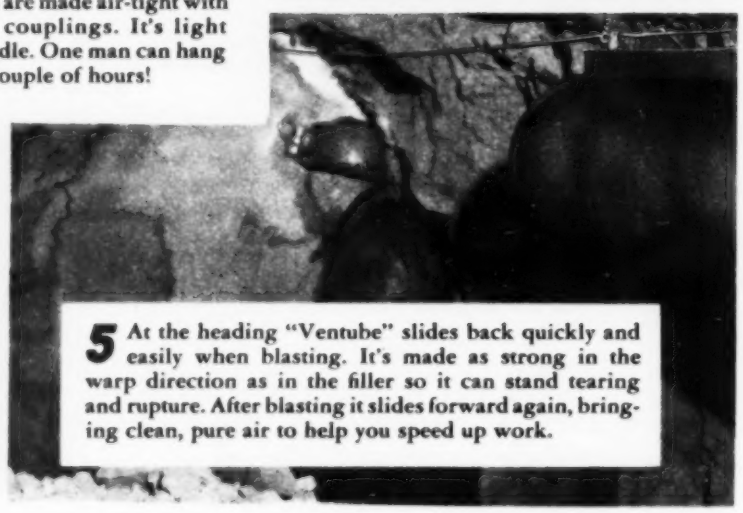


2 And here we go with "Ventube" down Shaft No. 1. Notice the T-joint. This makes it possible to direct air in two directions. When air is needed at only one heading, the opposite end can be shut off by means of a damper. It's as easy as that.

3 Here you see "Ventube" in one section of the tunnel. There are no kinks or bulges to impede the flow of fresh air through the smooth interior. Joints are made air-tight with patented "Ventube" couplings. It's light weight and easy to handle. One man can hang an entire system in a couple of hours!



4 Bottom of Shaft No. 3. Another T-joint sends fresh air through "Ventube" to both headings. "Ventube" is tough and durable . . . made of extra-heavy, long-fibered cloth woven to Du Pont standards. It's both coated and impregnated with rubber that *won't peel off.* Even the stitching is processed to resist rot.



5 At the heading "Ventube" slides back quickly and easily when blasting. It's made as strong in the warp direction as in the filler so it can stand tearing and rupture. After blasting it slides forward again, bringing clean, pure air to help you speed up work.

• More and more BIG tunnel jobs the country over are taking advantage of the ease and speed with which "Ventube" is handled . . . its amazing durability . . . the splendid results obtained! Install a few sections in your toughest working. See for yourself how "Ventube" can save you time and money. Write Du Pont today for facts and figures on "Ventube."

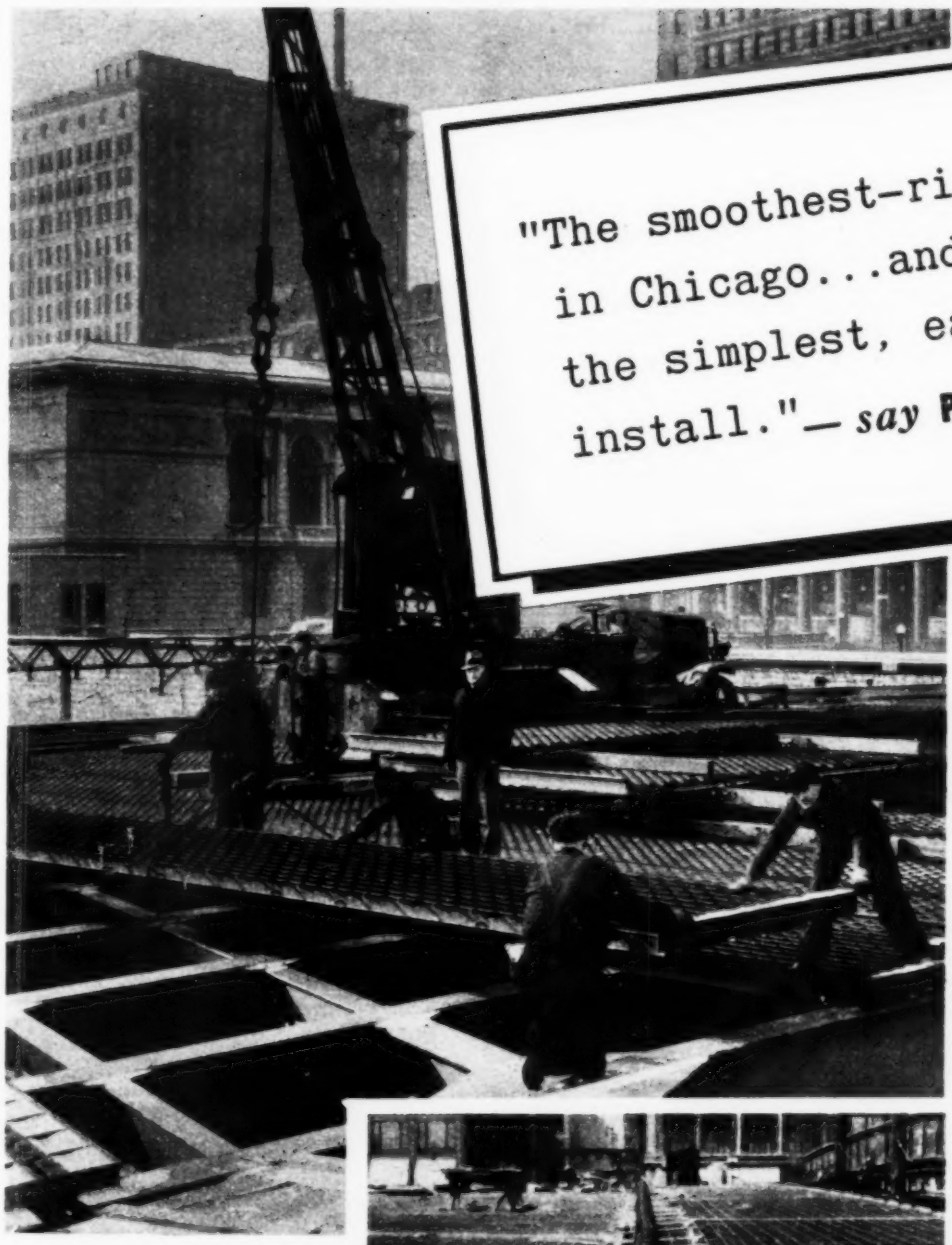
Visit the Du Pont "Wonder World of Chemistry" Exhibits at the New York World's Fair and on the Boardwalk at Atlantic City

DU PONT
VENTUBE
THE FLEXIBLE VENTILATING DUCT

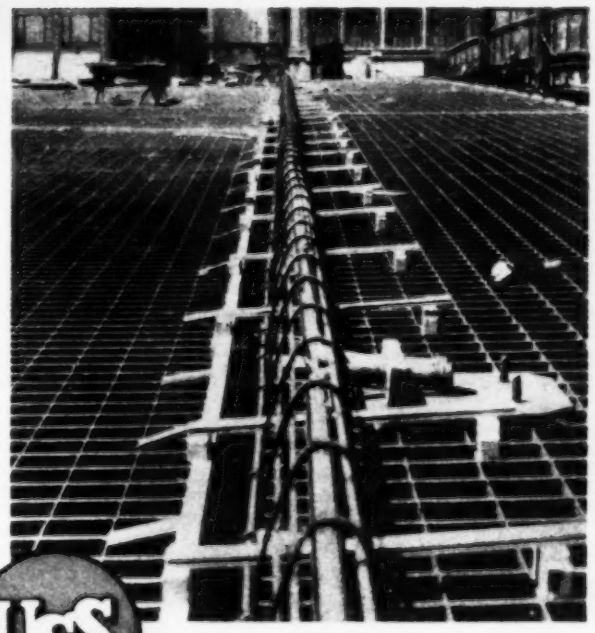
E. I. DU PONT DE NEMOURS & COMPANY (INC.)
"FABRIKOID" DIVISION • FAIRFIELD, CONN.

*"VENTUBE" is Du Pont's registered trade mark designating its rubber impregnated flexible ventilating duct.

● This roomy, compact powder bag is made of the same sturdy material as is "Ventube." The seams are sewed as tough as rawhide—and the fabric is coated and impregnated with thick, resistant rubber. Du Pont powder bags are available in several sizes. Write for sizes and prices.



"The smoothest-riding bridge deck in Chicago...and, incidentally, the simplest, easiest floor to install."— *say* **PARK DISTRICT ENGINEERS**



PLACING PANELS. In order that these floor panels would bear evenly and present a smooth, even surface, great care was taken in adjusting steel work prior to riveting, and to set each girder with top flange at exact elevation. No shimming was necessary.

THIS NEW VIADUCT was designed under the supervision of Lyman C. Riggle, Structural Designer, Chicago Park District. Field engineering was under the supervision of Lawrence T. Smith, Resident Engineer, Chicago Park District. General Contractors—Kettler-Elliott Company, Chicago, Ill.

THE new Monroe Street Viaduct built by the Chicago Park District across the Illinois Central-Michigan Central tracks in Grant Park, Chicago, graphically illustrates the important economies that can be effected by fully utilizing the possibilities of U·S·S I-BEAM-LOK Flooring.

Constructed to take care of the heavy vehicular traffic originating in the nearby Loop, this new viaduct is 85 ft. wide—25 ft. wider than the old structure it replaces. Has roadway 60 ft. wide—26 ft. wider than before.

"Lightness was essential in the new work," say the Park District engineers. "Because of the reduced slab dead load of the I-BEAM-LOK deck, considerable economy was secured by utilizing the old pile foundations. The fact that the 4¼" I-BEAM-LOK used, when filled with concrete, weighed only 55.5 lbs. per sq. ft. further enabled us to reduce deck thickness to secure a 2-foot reduction in crown, and also made it possible to use much lighter main girders."

Photographs shown here indicate how the job was handled. Although this construction was made over heavy railway traffic and was carried on above an overhead catenary system carrying 1500 volts, this difficult and dangerous project was completed without a single electrical accident. The ease of handling of the I-BEAM-LOK sections and the fact that no riveting or bolting was required, and that all welding was done downhanded from above the structure, speeded up the work, insured a better job, and were important factors in keeping the safety record clear.

Do you wonder that to date more than 3 million sq. ft. of U·S·S I-BEAM-LOK are in use? It has been used to refloor the famous Queensboro, Manhattan and Williamsburg spans in New York. It is used on the new Bronx-Whitestone Bridge—on the Thousand Island Bridge across the St. Lawrence—on the International Highway Bridge at Port Huron—on the Outer Drive Bascule Bridges at Chicago—and on other famous old and new structures designed by the most prominent authorities in the bridge engineering field. Find out about U·S·S I-BEAM-LOK—the modern floor for modern traffic. Our engineers will gladly discuss its economies and possibilities.

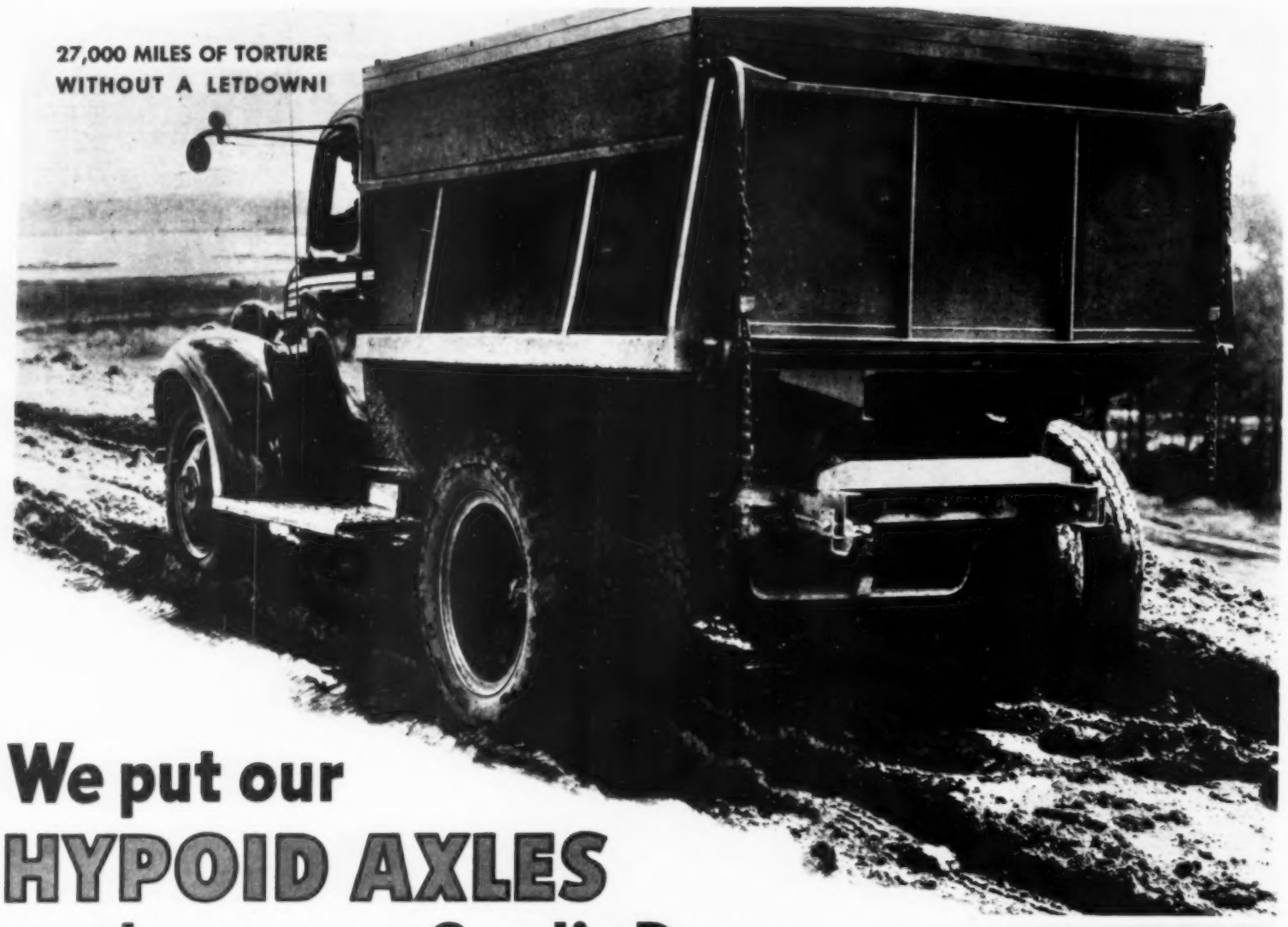
UNITED STATES STEEL

U·S·S I-Beam-Lok Armored Floor

CARNEGIE-ILLINOIS STEEL CORPORATION

Pittsburgh and Chicago

Columbia Steel Company, San Francisco, *Pacific Coast Distributors*
United States Steel Export Company, New York



We put our HYPOID AXLES to the test at Sardis Dam ·· *and look what happened!*

Down in Mississippi, at the Sardis Dam, Chevrolet found a truck proving ground that was death on rear axles. Millions of yards of gravel had to be moved, and moved fast. Trucks were carrying six-ton loads over a rutted road, up a quarter-mile 24 per cent grade.

No truck can take that kind of punishment indefinitely—and rear axles suffered a high mortality.

Chevrolet engineers eagerly accepted the challenge. They yanked the bevel gear axles out of two 1939 Heavy Duty trucks, and installed Chevrolet's new 1940 hypoid-gear rear axles.

What happened? Conventional axles were having trouble on an average of every 7,725 miles—but these 1940 hypoids did 27,000 miles without a failure. That was proof enough for our engineers. They brought those axles to Detroit, and found them still good for more thousands of miles.

Few trucks have to take such a beating as these two Chevrolet trucks took. But Chevrolet engineering demands that its trucks shall have extraordinary reserve strength. So—today—all new 1940 Chevrolet trucks have this vastly stronger, more efficient, and longer-lived rear axle. Hypoid means low costs.

From the gravel pit to Sardis Dam are ten miles of rough going and steep grades. Here Chevrolet's 1940 hypoid-gear rear axles proved their superiority over spiral-bevel-geared axles.

LEFT—NEW HYPOID PINION

RIGHT—CONVENTIONAL SPIRAL BEVEL PINION

These two drive pinions fit the same size ring gear—yet the hypoid pinion is 53.6% heavier, and has 37% greater tooth contact and 20% lower tooth pressure.

CHEVROLET MOTOR DIVISION, *General Motors Sales Corporation*, DETROIT, MICH.

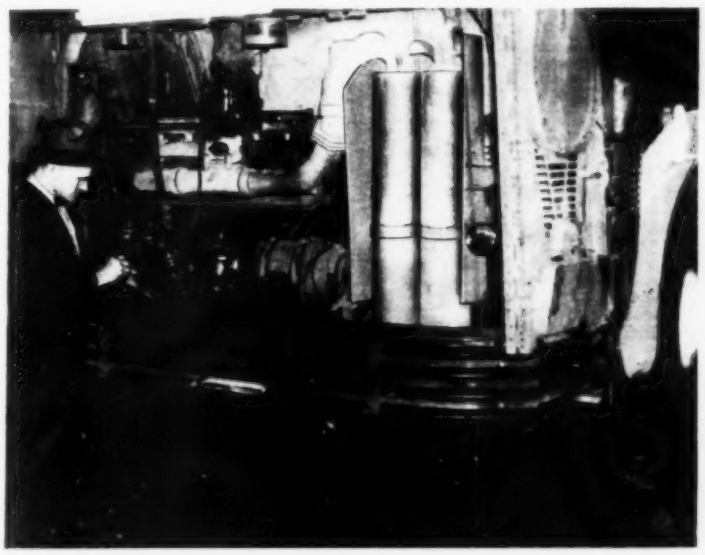
CHEVROLET TRUCKS

GAS CONSUMPTION CUT 5% TO 15%!

Officials of a South Dakota city were spending from 5% to 15% more of the taxpayer's money per truck for gasoline than they needed to. They didn't know it until a Standard Automotive Engineer made thorough tests of their 16 truck units, and told them so. He told them exactly how to avoid this waste, and they did. There was no charge for the tests or the advice – there never is.

The tests these men conduct are unusually thorough, their recommendations always highly practical. If you are a user of Standard Oil products, and operate a fleet, don't pass up this costless opportunity to *prove* your fleet's efficiency – or to score new records of economy in the months ahead! Call in a Standard Automotive Engineer.

Systematic tests, careful records, and practical recommendations led to large savings.



The Standard Automotive Engineer included regular inspection of air cleaners in his recommendations.

10 YEARS' SERVICE TO BUS COMPANY EFFECTS MANY SAVINGS

A bus line that uses *three million gallons* of gasoline a year, and operates approximately 55,000 *miles per day*, is naturally interested in *economy of operation!* So are Standard Automotive Engineers. The two have been working together for ten years, now. The bus line's business has naturally been valuable to Standard Oil. But the savings effected have been mighty important to that bus line, too! In 1936 gasoline mileage was increased nearly one mile per gallon. When the line changed to rear drives new difficulties were rectified which again bettered mileage nearly one mile per gallon! Those are only the spectacular savings. Standard Engineers have been on the job steadily for ten years, correcting vapor lock, effecting economies on motor oil, checking filters, ignition, wheel bearing lubrication, etc. Once the line used 15 barrels of grease per month at one terminal, for chassis lubrication. Now it uses less than *seven* at that terminal.

That was a *big* job! Standard Automotive Engineers never "high hat" small problems. Have you some?

MILEAGE INCREASED 17% WITH STANDARD RED CROWN!

This was a strictly competitive business solicitation. "If we can show you a real saving on a fair test, using our service, will you buy our products?" It was the kind of an offer in which the customer *can't lose*. In this case he won a 17% saving on gasoline mileage! Read the quotation at the right.

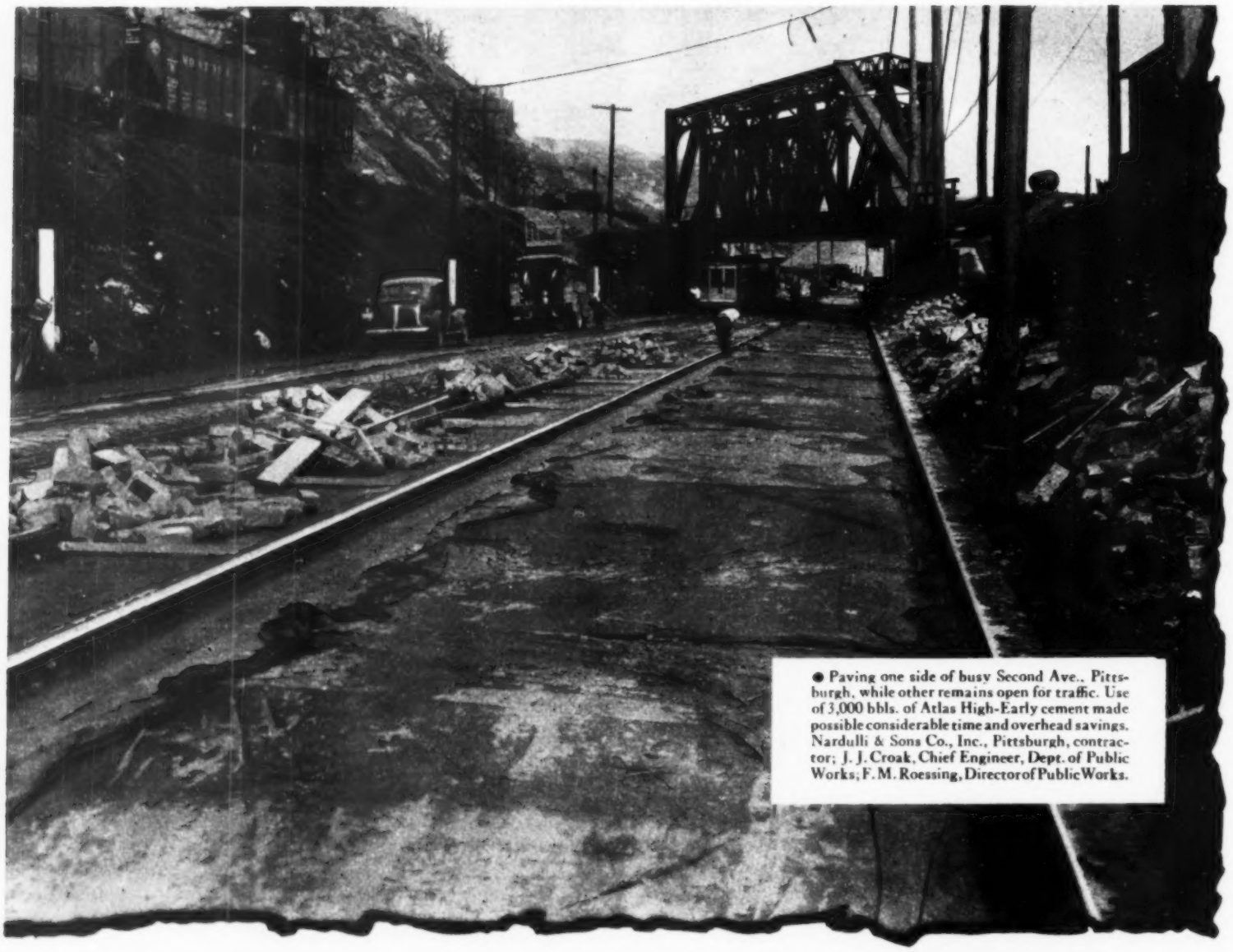
Why don't *you* challenge a Standard Automotive Engineer to uncover *new* economies for you? You can't lose! Reach him through your local Standard Oil (Indiana) office, or write 910 S. Michigan Avenue, Chicago, Illinois.

Mr. Albert B. Duquette, owner of the Oak Beverage Company, Royal Oak, Michigan, writes: "After using your engineering service, we discovered our mileage, using Standard Red Crown Gasoline, was increased 17%. Inasmuch as our trucks cover approximately 450,000 miles per year, you can see why we are so enthused and appreciative of this service!"

STANDARD OIL COMPANY (INDIANA)

LUBRICATION ENGINEERING *THE RIGHT LUBRICANT • PROPERLY APPLIED TO REDUCE COSTS*

REWARDED FOR SPEEDING on a busy road!



● Paving one side of busy Second Ave., Pittsburgh, while other remains open for traffic. Use of 3,000 bbls. of Atlas High-Early cement made possible considerable time and overhead savings. Nardulli & Sons Co., Inc., Pittsburgh, contractor; J. J. Croak, Chief Engineer, Dept. of Public Works; F. M. Roessing, Director of Public Works.

THE extremely heavy automobile and street-car traffic on Pittsburgh's Second Avenue forced complete repaving. Problem was to get this job done in the shortest possible time, with the least possible traffic tie-up.

The contractor knew he could make a large saving in repaving time by getting rid of long protection and curing delays. So he used a cement that gains strength rapidly—Atlas High-Early cement! First the base for one side of the road was concreted. Then—within a minimum amount of time—the contractor switched traffic and started concreting the other side.

The rewards? Each strip of road was ready for traffic much earlier than would otherwise have been possible. The job was done in winter weather, and so several days' protection and curing time was saved. Added up, these items made a substantial time and overhead saving!

Speed up your road, bridge and other construction by using Atlas High-Early cement. Although this cement costs slightly more, the savings in time and overhead often more than pay for the extra cost. For more facts, write Universal Atlas Cement Co. (United States Steel Corp. Subsidiary), Chrysler Building, New York City.

CM-H-15

ATLAS HIGH-EARLY CEMENT

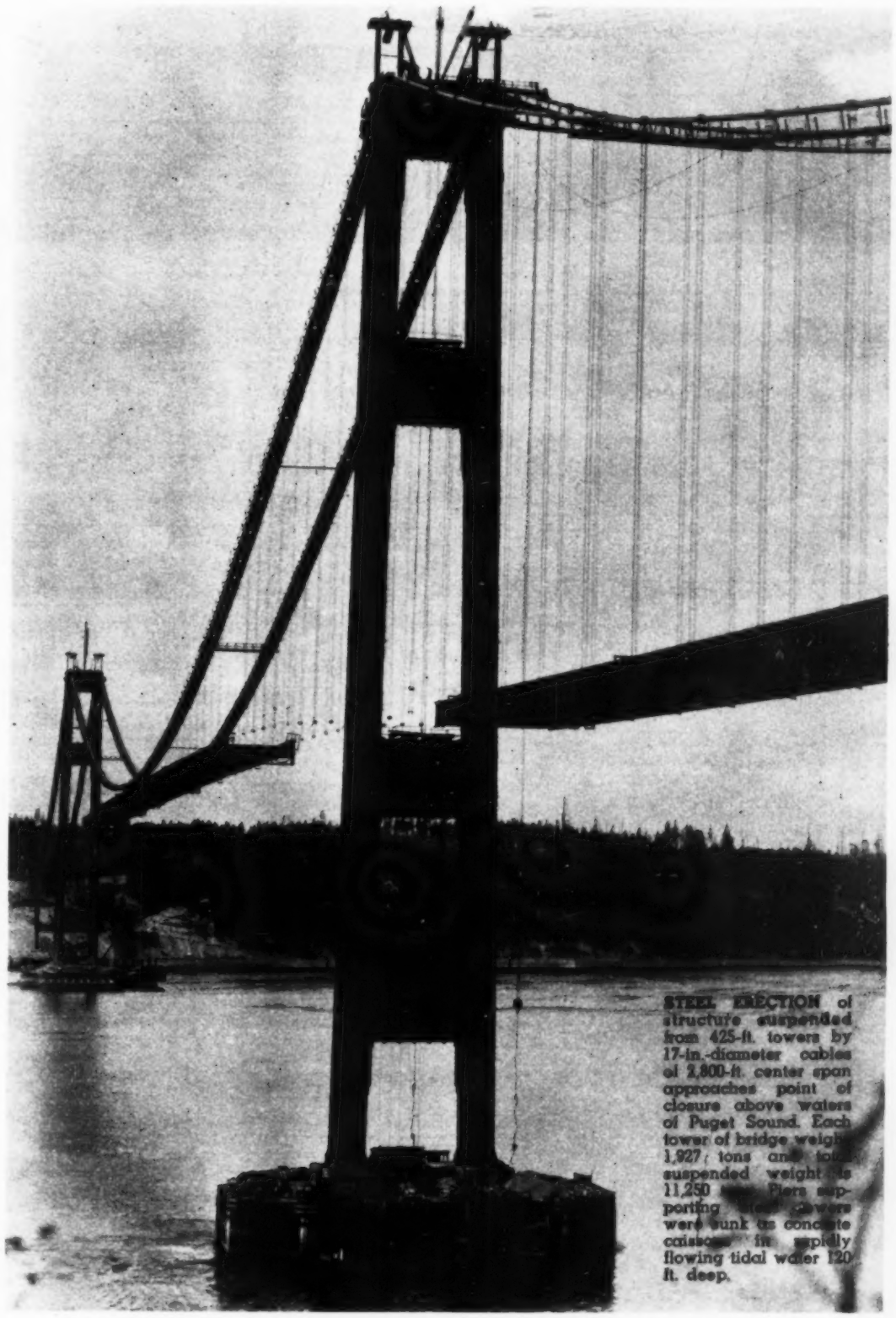
A UNIVERSAL ATLAS PRODUCT

Construction Methods

ROBERT K. TOMLIN, Editor

Volume 22 | JUNE, 1940 | Number 6

Tacoma Narrows Bridge NEARS COMPLETION



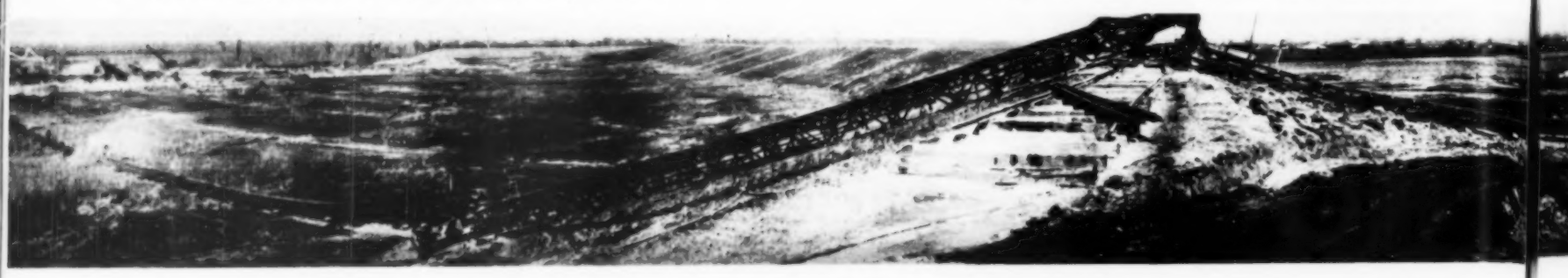
STEEL ERECTION of structure suspended from 425-ft. towers by 17-in.-diameter cables of 2,800-ft. center span approaches point of closure above waters of Puget Sound. Each tower of bridge weighs 1,927 tons and total suspended weight is 11,250 tons. Piers supporting steel towers were sunk as concrete caissons in rapidly flowing tidal water 120 ft. deep.

WITH THE SUSPENDED STEEL STRUCTURE approaching the closing point and 75 per cent of the floor framing erected in the photograph herewith (taken late in April), the Tacoma Narrows bridge at Tacoma, Wash., with a main cable suspension span of 2,800 ft. and side spans of 1,100 ft. each, has progressed to a stage which the Washington Toll Bridge Authority believe will make it possible to place the concrete deck and open the structure to traffic early in July.

Supported by steel towers 425 ft. high resting on concrete caisson piers sunk in water 120 ft. deep, each of the two 17-in.-diameter cables consists of 19 strands, each strand containing 332 wires, or a total of 6,308 wires in each cable. Contract for the bridge, amounting to $5,950,000 was awarded to the Pacific Bridge-General-Columbia Co., with the Bethlehem Steel Co. handling the cable spinning and steel erection. For the Washington Toll Bridge Authority Lacey V. Murrow is chief engineer, Clark H. Eldridge, bridge engineer, and C. E. Andrew, consulting engineer.

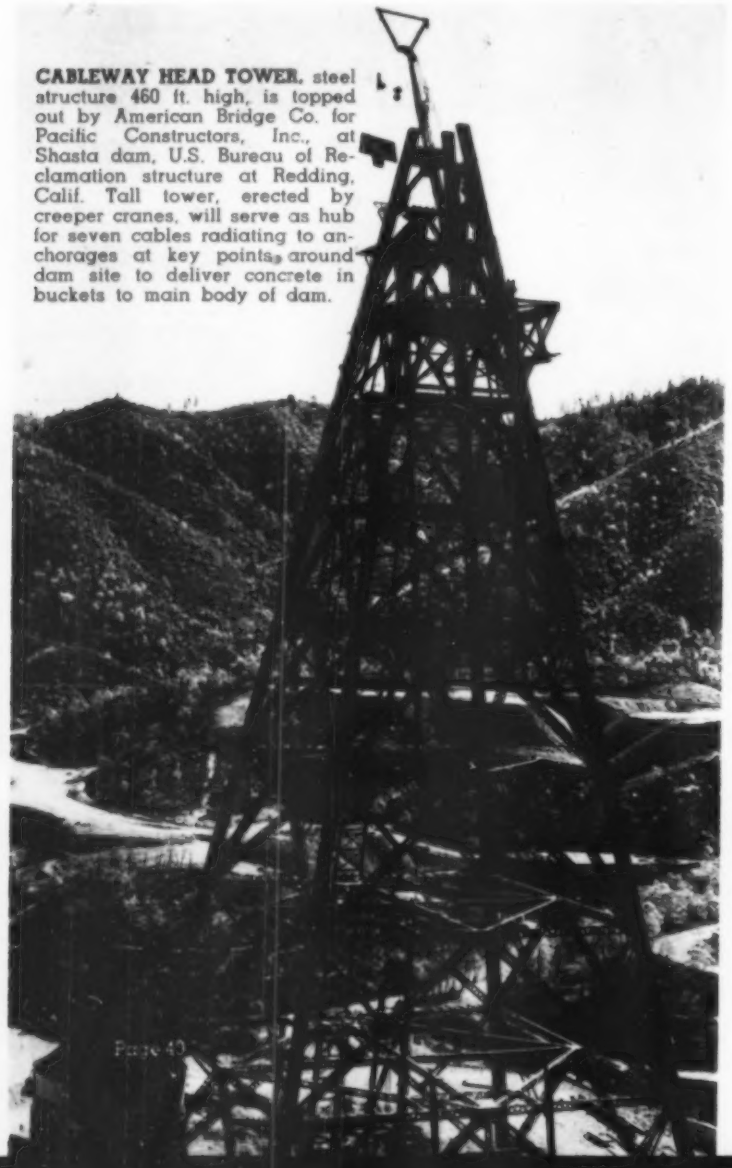
FLOATING BRIDGE OF CONCRETE PONTOONS, anchored by cables to lake bottom, forms unique 1.3-mi. crossing which will be opened to traffic over Lake Washington at Seattle, Wash., in July. Floating section of bridge includes 25 pontoons. Ten standard pontoons are cellular flat-bottom concrete boats 350 ft. long, 59 ft. wide and 14 ft. 3 in. deep; sides and bottoms are 8 in. thick. Fifteen special pontoons range in length from 117 to 378 ft. Pontoon units are rigidly connected by heavy bolts. Floating structure 6,561 ft. long, with 45-ft. roadway, is connected to shores by steel truss spans. Bridge is being completed under $3,254,000 contract by Pontoon Bridge Builders for Washington Toll Bridge Authority of which L. V. Murrow is chief engineer, Charles E. Andrew, principal consulting engineer, and R. M. Murray, bridge engineer.

CHARLESTOWN MASS HOUSING PROJECT in shadow of Bunker Hill near Boston, Mass., nears completion under direction of Boston Housing Authority. Total of 44 buildings with reinforced



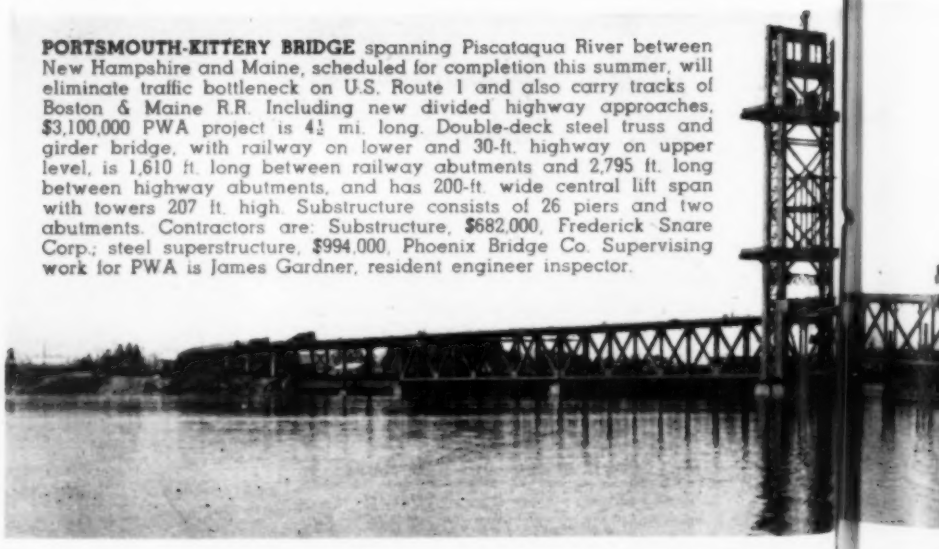
BELT CONVEYORS ENLARGE LEVEE along Mississippi at Friar's Point, Miss., transporting 620,000 cu.yd. of earth from borrow pits located as far as 1,800 ft. distant from existing embankment 42 ft. high and 350 ft. wide at base. On length of 1,100 ft. of levee, Noonan & Ray, contractors, of Pensacola, Fla. handle average of 300 cu.yd. per hour with series of 42-in. wide Link-Belt conveyors, loaded by three crawler draglines working in borrow pit, at extreme left of picture. As work progressed, conveyor system was moved sideways 40 to 60 ft. by three tractors hitched to one side of steel frameworks of conveyor units which were mounted on log type rollers.

CABLEWAY HEAD TOWER, steel structure 460 ft. high, is topped out by American Bridge Co. for Pacific Constructors, Inc., at Shasta dam, U.S. Bureau of Reclamation structure at Redding, Calif. Tall tower, erected by creeper cranes, will serve as hub for seven cables radiating to anchorages at key points around dam site to deliver concrete in buckets to main body of dam.



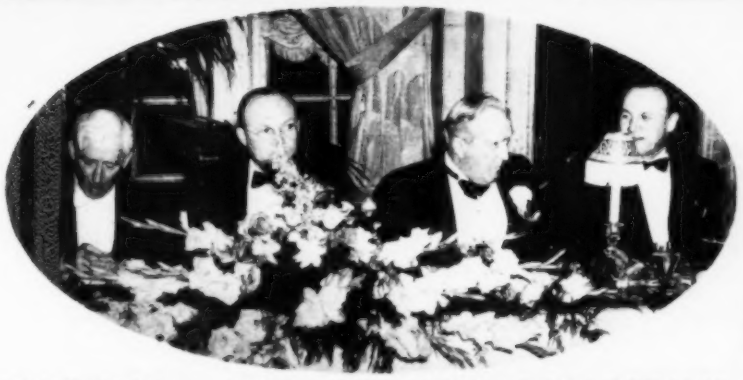
THIS MONTH'S NEWS REEL

PORTSMOUTH-KITTERY BRIDGE spanning Piscataqua River between New Hampshire and Maine, scheduled for completion this summer, will eliminate traffic bottleneck on U.S. Route 1 and also carry tracks of Boston & Maine R.R. Including new divided highway approaches, $3,100,000 PWA project is 4½ mi. long. Double-deck steel truss and girder bridge, with railway on lower and 30-ft. highway on upper level, is 1,610 ft. long between railway abutments and 2,795 ft. long between highway abutments, and has 200-ft. wide central lift span with towers 207 ft. high. Substructure consists of 26 piers and two abutments. Contractors are: Substructure, $682,000, Frederick Snare Corp.; steel superstructure, $994,000, Phoenix Bridge Co. Supervising work for PWA is James Gardner, resident engineer inspector.



concrete frames and brick facing, three-story structures, are being completed under $3,398,000 contract by John Bowen Co., contractor, of Boston, from plans by John M. Gray, Boston architect.

FOURTH AND FINAL FOUR-LEGGED CAISSON for Ludlow Ferry bridge across Potomac River 50 mi below Washington, D. C., is sunk to prepared timber platform, on piles 10 ft. below river bed by releasing air from four corner cylinders, under supervision of Frank W. Barnes, construction manager, and William Denny, superintendent, for Merritt-Chapman & Scott Corp., New York, which completes $2,100,000 substructure contract this month. Operation of floating 160-ton steel caisson, measuring 41½x36¼ ft. between shaft centers by 38 ft. high, towing it 2½ mi. to site and landing it in final position is finished May 8 in less than 6 hr. Open-bell bottoms of cylinders fit over clusters of steel H-piles driven to rock through holes in timber mat by 16-ton steam hammer. J. E. Greiner Co., Baltimore, is consultant in charge of design and construction for Maryland State Roads Commission.



ROAD BUILDERS assemble in Washington, D. C. at annual spring meeting, May 7-10, of American Road Builders' Association to install new president, HAL G. SOURS, (second from left) state highway engineer of Ohio. Those in group at banquet are (left to right): GAR WOOD, Detroit equipment manufacturer; HAL G. SOURS, president, A.R.B.A.; Senator PAT McCARRAN, of Nevada; and MURRAY D. VAN WAGONER, retiring president and State Highway Commissioner of Michigan.

Highway Information Service Photo

OPEN STEEL GRID DECK (right) replacing old wood floor, is welded to stringers of bridge spanning Mississippi River at Clinton, Ia. Lyons & Fulton Bridge Co. maintains traffic across structure by laying grating in sections. Welding is done with General Electric portable a.c. arc-welders and electrodes.

WELDED STEEL TUBE SECTION (below) of new Bankhead vehicular tunnel under Mobile River at Mobile, Ala., is floated to place and sunk in dredged trench by Arundel Corp., of Baltimore, Md. Under-river portion of single tube carrying two traffic lanes is 2,000 ft. long, consisting of five 298-ft. main sections and two 255-ft. end sections. Octagon-shaped steel shell is lined with concrete to give finished inside diameter of 27 ft., with exhaust air duct under 21-ft. concrete roadway. Steel tube sections were fabricated by welding at yard of Alabama Drydock & Shipbuilding Co., fitted with temporary bulkheads and towed ½ mi. to site. Sinking was done by lowering tube with 15-ton chain blocks from gallows frame of H-section steel piles supporting I-beams.

ON NORRIS DAM, first of TVA's large projects, constructors employ double panels to form monoliths. After concrete (placed inside upper belt of panels) has hardened, mobile hoist car strips and raises lower course of panels.

First of a Series of Articles Dealing With Form Design, Manufacture, Handling and Cost-Keeping Methods

By H. P. MAXTON
General Cost Engineer,
Tennessee Valley Authority,
Knoxville, Tenn.

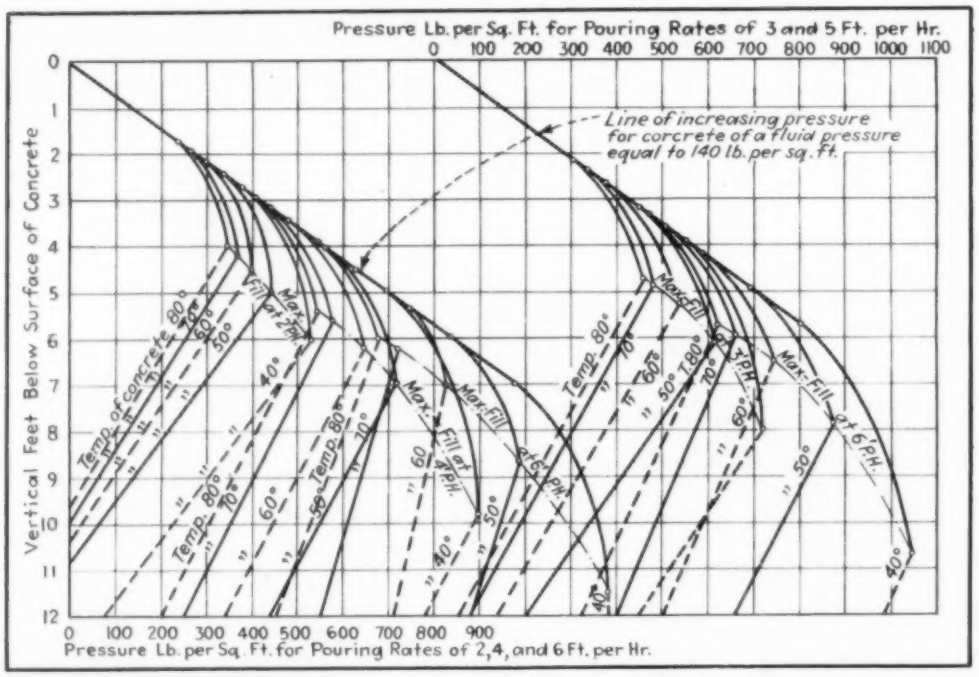
FORMWORK FOR CONCRETE often offers the largest single opportunity for cost control on heavy construction. The item certainly deserves study and consideration equal to that given to cofferdam and plant design and layout and to earth and rock moving, but all too frequently the planning for construction and handling of formwork is left largely in the hands of the carpenter foreman, who then exercises almost sole control of the important costs involved.

Because of the great quantities generally required, large savings can be made by properly pre-planning formwork construction. To demonstrate the expenditures involved in form construction: (1) A 500,000-cu.yd. dam may have 1.5 sq. ft. or more contact area of formwork per cubic yard, or 750,000 sq.ft. contact area for the mass concrete alone. (2) A 200,000-cu.yd. navigation lock may have 3.5 sq.ft. contact area per cubic yard of concrete, or a total of 700,000 sq.ft. (3) A 10,000-cu.yd. power-house superstructure (beams, columns and decking) may have 25 sq.ft. contact area per cubic yard of concrete. or a total of 250,000 sq.ft.

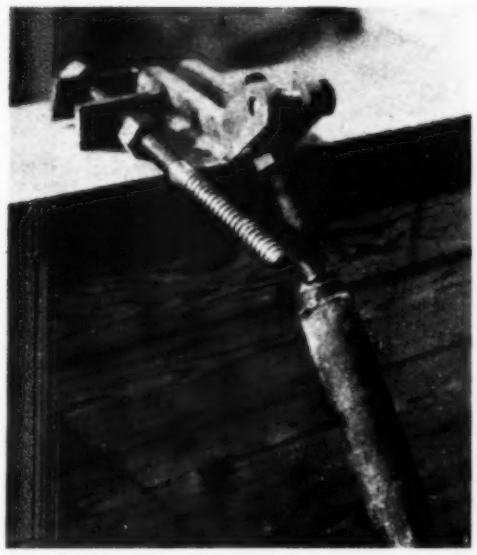
A complete project, including dam, lock and power house, may involve a total of, say 3,000,000 sq.ft. contact area. Some of the largest construction projects require a great deal more. Remember, the feet, b.m., of lumber used is no small item alone, even if multiple-use panel forms can be employed on a large part of the job. In terms of cost, the tremendous quantity of formwork becomes a large percentage of the total cost of concrete, as the accompanying tabulated breakdown of concrete costs, taken from actual records, serves to show.

Form costs may range from less than 25c. to well over $1 per square foot contact area, depending on whether (1) shop-constructed panels are so suited to the work that they can be employed economically and reused many times, thus spreading the first cost, or (2) the work requires built-in-place forms which present difficult problems of framing and joining and which must be completely destroyed during removal.

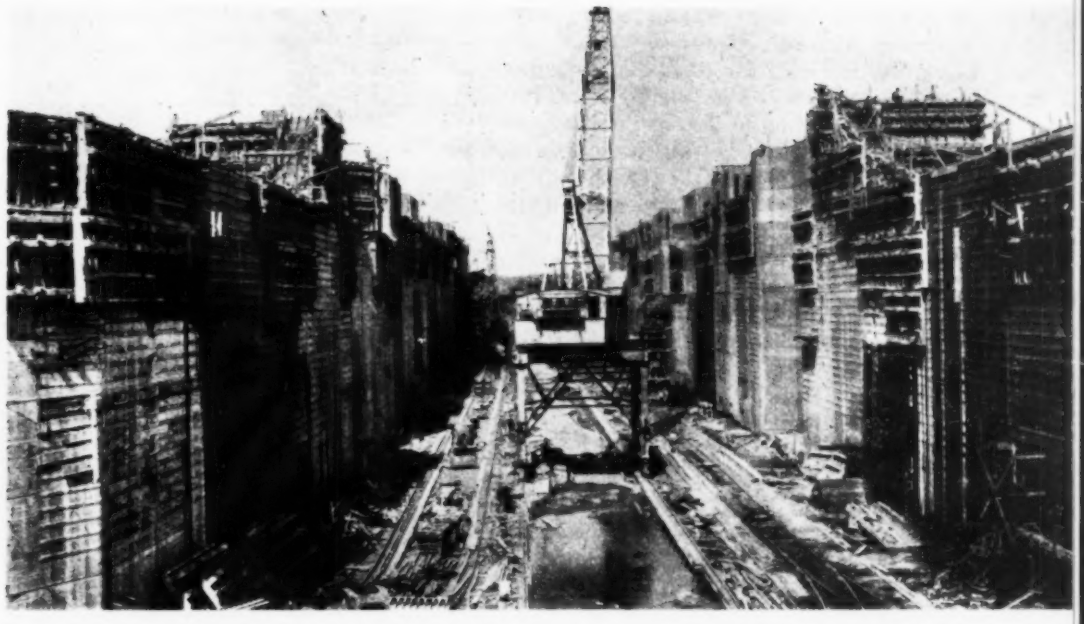
Shop-fabricated, multiple-use panels, straight and curved, of wood, steel or


Pressure Lb. per Sq. Ft. for Pouring Rates of 3 and 5 Ft. per Hr.
0 100 200 300 400 500 600 700 800 900 1000 1100
Vertical Feet Below Surface of Concrete
0 1 2 3 4 5 6 7 8 9 10 11 12
Line of increasing pressure for concrete of a fluid pressure equal to 140 lb. per sq. ft.
Temp. of concrete 80°
" " 70°
" " 60°
" " 50°
Max. Fill at 2 Ft. per Hr.
Temp. 80°
" 70°
" 60°
" 50°
" 40°
Max. Fill at 4 Ft. per Hr.
Max. Fill at 6 Ft. per Hr.
0 100 200 300 400 500 600 700 800 900
Pressure Lb. per Sq. Ft. for Pouring Rates of 2, 4, and 6 Ft. per Hr.

PRESSURES AGAINST FORMS given by these curves for concrete of fluid pressure equal to 140 lb. per square foot may be considered ample for vibrated concrete in widely spaced forms such as are used in block construction on locks and dams. Curves also may be used where high-slump concrete is placed without vibrators in narrow forms. Where narrow forms, vibrators and high rates of pour are employed, a pressure equal to that of a fluid of the same weight as the concrete should be assumed for the full depth of the forms.



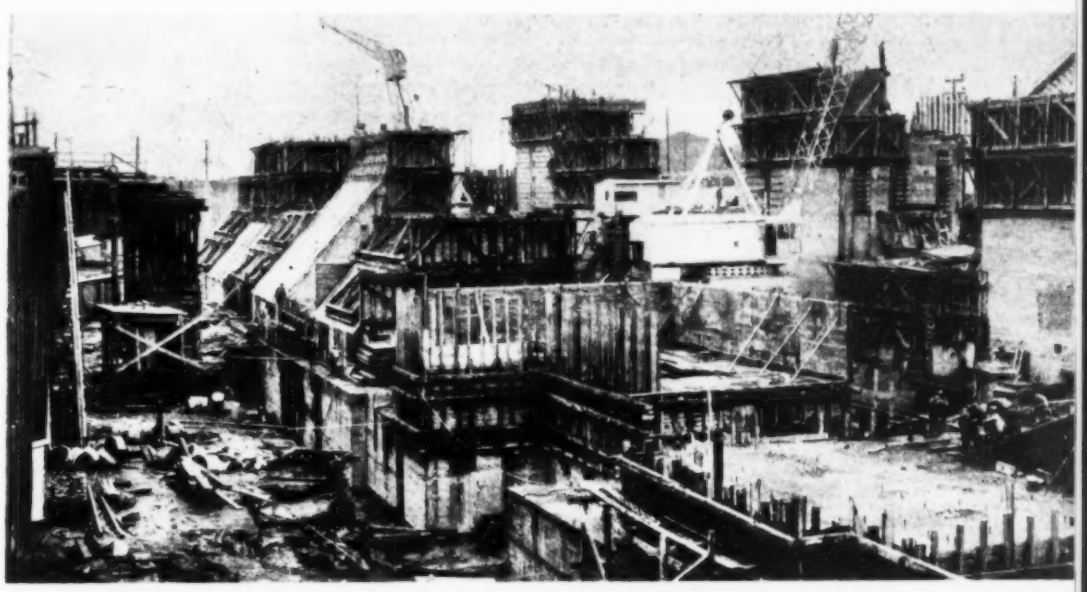
TO SPEED ERECTION and stripping of forms, designers utilize fixtures with widely spaced threads, as indicated by this Tylag bolt for top wale anchor on Chickamauga panel.



DOUBLE-COURSE PANELS serve to form armored lock walls of Pickwick Landing project. Note fillers at left, used between armor strips in lock wall. Revolving crane has 5½-ton capacity at 90-ft. radius.

composition material, have been used for many years in constructing reservoirs, silos, buildings, bridges, viaducts, sewers and similar structures. On large jobs, fabricated panels offer a means of reusing the same forms many times, in contrast to the generally more expensive method of building and wrecking formwork for each placement of concrete.

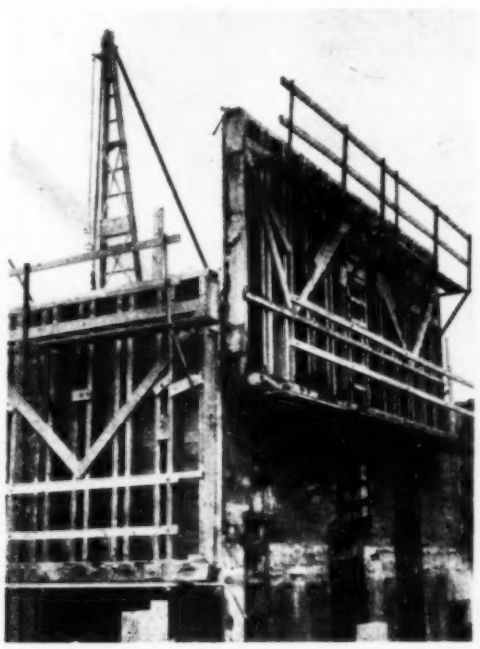
We should raise the questions: (1) Are panel forms economical? (2) When are they economical? (3) Are they economically foolproof—that is, are they inherently so easily handled, erected and stripped that the field constructors and strippers cannot go wrong and make them expensive to use? To answer the last question first, the cost problem is

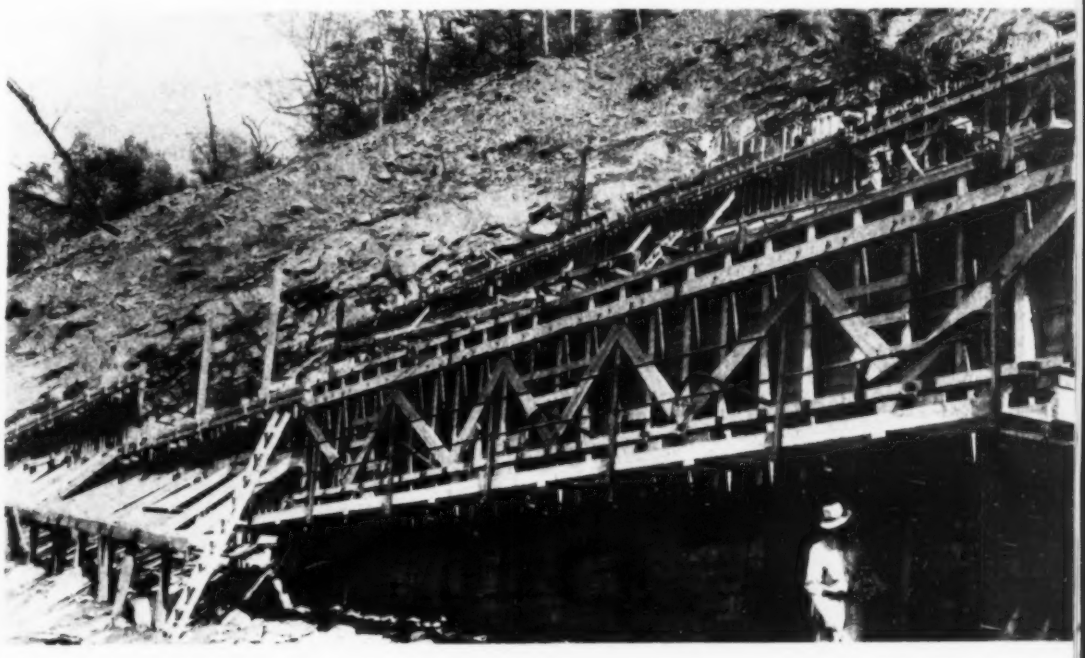


AT GUNTERSVILLE LOCK (above), double panels are chosen to form concrete blocks.

HIWASSE DAM PANEL (below) is constructed of lumber meeting specifications listed in accompanying notes. TVA designers again choose single-course panels for this project.

FOR GREATER ECONOMY in handling and erection of forms **(below)**, TVA designers change to single-course panels on Chickamauga lock and dam. A-frames equipped with ratchet-lever chain hoist are used to raise panels. Note safety scaffold permanently attached to form unit.





only partly solved when panels are properly designed. There is ample opportunity for field forces to deliver very costly formwork when adequate supervision, control and study are lacking. A subsequent section of this article will discuss "Handling Forms in the Field."

Panel forms are definitely economical if used in the proper place, provided they are properly designed, properly constructed and properly handled. To obtain the maximum number of uses, consistent with required progress, *do not overbuild!* It is better to have to fabricate a few additional panels during the course of the job than to have a large number of perfectly good panels left over at the end.

If panels can be employed more economically than built-in-place formwork and in sufficient quantity to justify their construction, it naturally follows that

(Continued on page 93)

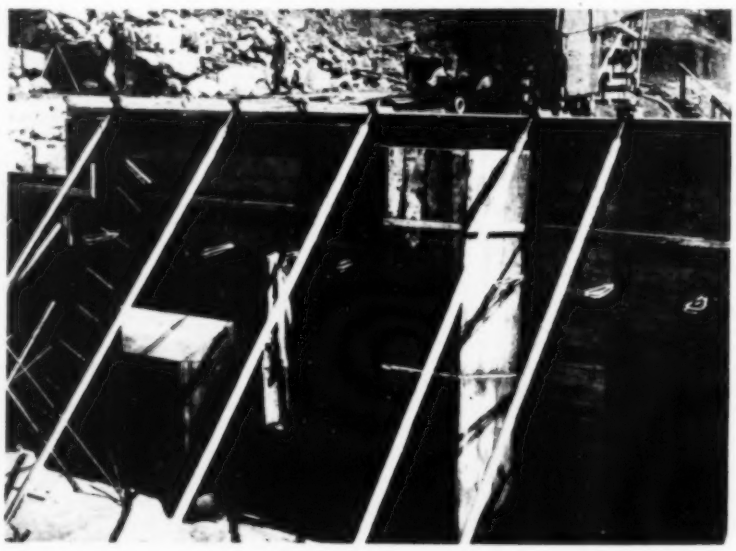
WOOD PANEL FORMS FOR DAM AND LOCK CONCRETE

	Norris Dam, mass	Pickwick Landing, lock	Chickamauga, lock**	Guntersville lock**	Madden Dam, mass
Number of panels	242 bulkhead 106 upstream 128 downstream 476	42 step 317 vert. 50 slope 409	25 step 175 vert. 20 slope 220	130 vert. 10 slope 140	
Sq. ft. panels built	42,185	97,497	42,438*	24,427	63,000
Lumber, ft., b.m.	214,409	433,911	247,829	192,000	
Ft., b.m., of lumber per sq. ft. of panel area	5.1	4.5	5.8	7.9	
Sq. ft. panels erected	862,222	613,801	363,566	150,386	555,000
Total contact area, sq. ft.	1,120,034	1,056,784	615,817	473,873	747,000
Per cent of total area formed with panels	77	58	59	32	74
Average uses per panel	20	6	10	6	9
Concrete yardage	886,919	287,117	198,806	120,638	492,000
Sq. ft. contact area panel forms per cu. yd. concrete	0.97	2.14	1.83***	1.25	1.52

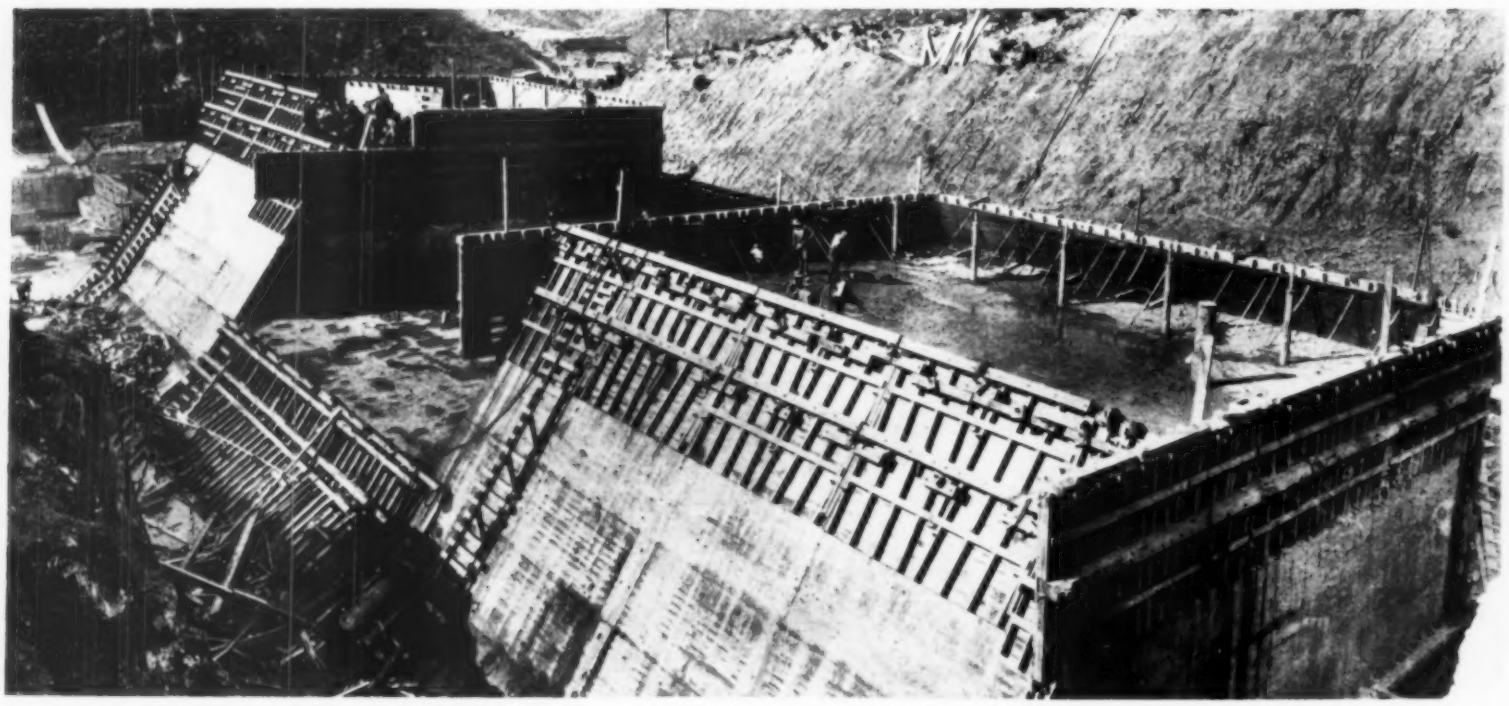
* 36,073 sq. ft. panel forms utilizable area
** Does not include upper miter sill
*** Additional use of panels was obtained in power house and spillway sections.

BREAKDOWN OF CONCRETE COSTS

	PERCENT OF TOTAL COST PER CUBIC YARD				
	Mass Concrete	Lock Concrete	Intake Structure	Power House Superstr.	Spillway Bridge
Cement and Aggregate (1st cost)	46.6	37.8	18.9	9.6	9.8
Unload & Handle Cement and Aggregate	4.2	6.7	3.1	2.1	2.9
Concreting Operations	14.4	14.6	14.5	18.9	21.9
Plant Depreciation	10.7	7.7	4.5	2.2	1.3
Reinforcing Steel	7.5	.7	21.1	11.0	9.7
Formwork	16.6	32.5	37.9	56.2	54.4
	100.0	100.0	100.0	100.0	100.0
Appx. Total cost per Cu.Yd.	$5.50	$7.00	$15.00	$30.00	$40.00

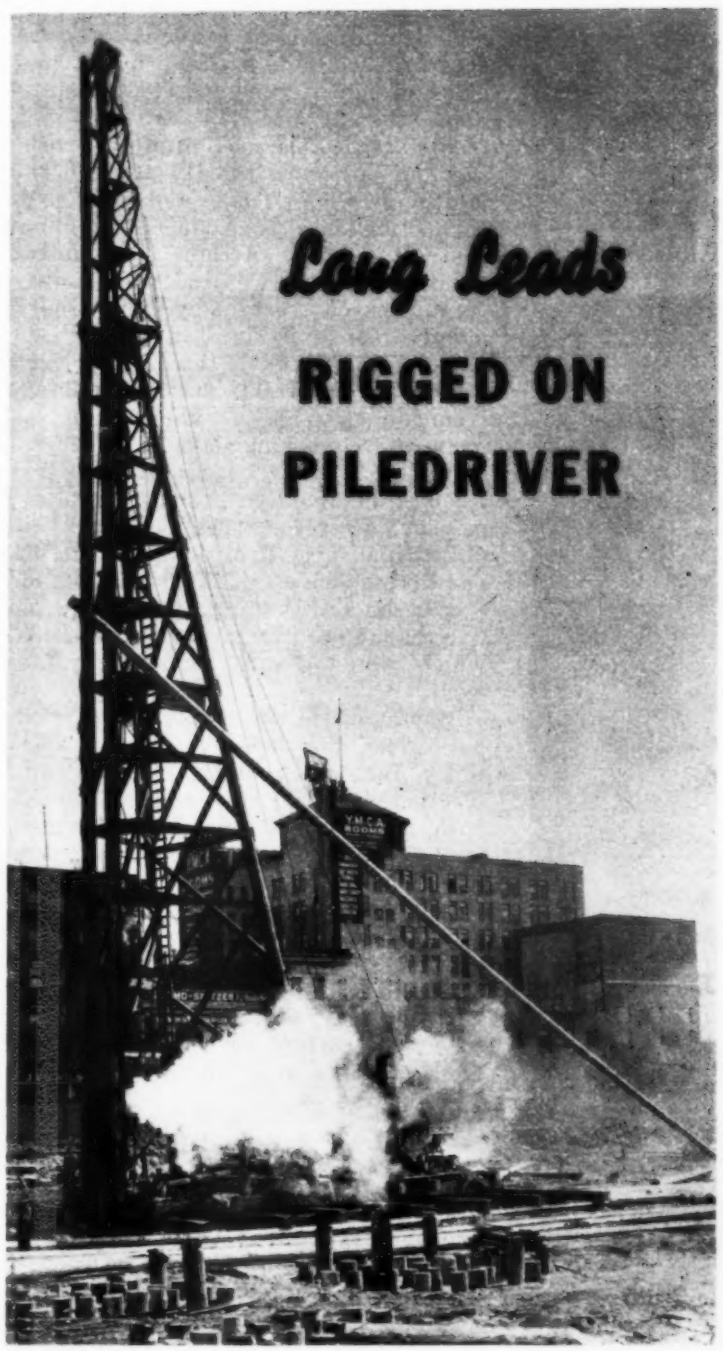


TOP ANCHORS for inclined ties are recognized as cost-saving feature in design of wood panel forms, as exemplified by units employed at Chickamauga lock and dam. Tyloop assemblies are inserted through forms for embedment in next lift of concrete.



CONCRETE LIFTS (below) 5 ft. high in large monoliths of Norris dam are placed inside upper belt of two-course panel forms. Inclined ties pass through upper wale of forms. On block in background is small mobile crane used in stripping and raising panels.

Long Leads RIGGED ON PILEDRIVER



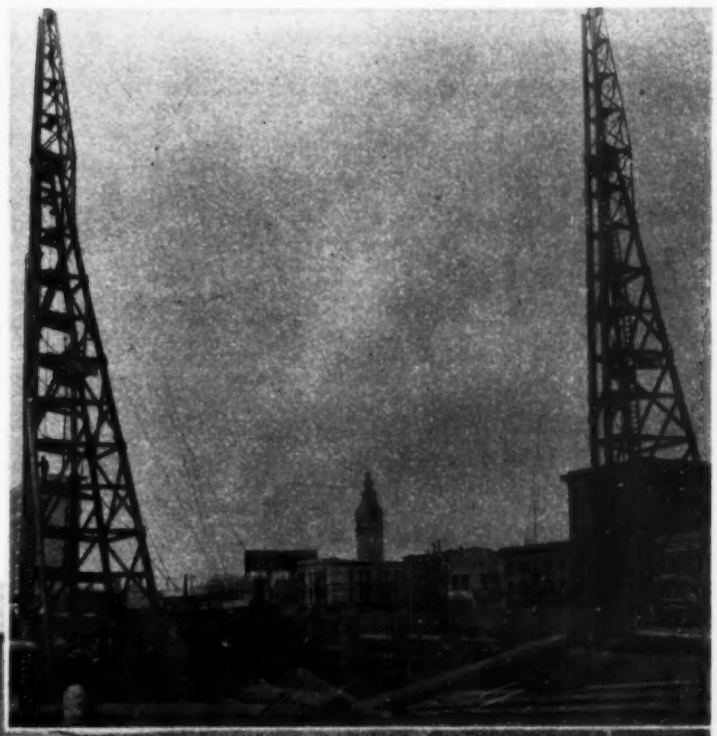
DOUGLAS FIR PILE 126 FT. LONG, single stick, is being hoisted into 135-ft. leads for driving.

PILEDRIVING LEADS 135-ft. high, required for a job recently completed in San Francisco, were built partly of timber and partly of steel because there were serious objections to using either material exclusively. Long Douglas fir piles were required for a Post Office building near the waterfront where soft mud is of such depth that dependence for support must be placed on the skin friction of long piles. Specifications called for piles up to 150 ft. long which, of course, meant splicing. However, many of the splices could be avoided if piles of maximum length were available. Accordingly, special shipments of long piles were brought from the Northwest; many of the lengths ranged up to 126 ft.

With these long piles and with the special leads to handle them, it was necessary to splice only 2,500 of the 4,000 piles required for the job. Two of the special drivers were constructed, thus reducing the time required for driving the 6,500 piles (counting the spliced piles as two) were put down in less than four months.

Under the plan of constructing piledriver leads used on the West Coast, the framing is done with the leads lying flat on the ground, and the completed tower is raised without the aid of derrick or gin pole. Under this plan, bending stresses in the tipping-up process are such that 135-ft. leads would exceed the safe limit. Accordingly, 100-ft. leads were erected and with the aid of a "floating gin pole" hoisted in the leads and held there near the top, a 35-ft. addition of prefabricated steel was bolted into place on top of the timber structure. This scheme had the advantage that when the post office job was completed, the steel superstructure on the rig could be dismantled, leaving leads of a length suitable for ordinary piledriving jobs.

The work was done under the control of the Federal Works Agency, Public Buildings Administration, George P. Hales, construction engineer. The special drivers were designed and built by the firm that held the piledriving contract, Ben C. Gerwick, Inc.



THESE TWO PILEDRIVERS (right) have timber towers 100-ft. high on top of which 35-ft. steel extension is mounted.

LONG PILES WERE SHIPPED on three-flat-car combination and from railroad siding were brought to job by Ross carrier.

CONCRETE PILE BENTS REMOVED INTACT BY *Crane-Operated Rig*

BY EXTRACTING, transporting and re-installing concrete pile bents at a rate of four to seven units per 8-hr. day, a specially designed crane-operated hoisting apparatus and attendant battery of jet points speeded the moving of 407 existing four-pile bents for a boardwalk relocation at Coney Island and facilitated completion of a $767,000 construction contract by The Arthur A. Johnson Corp. and Necaro Co., Inc., well-known New York contractors, within a four-month time limit specified by the Department of Parks of the City of New York. The contract period, running from Jan. 15 to May 15, allowed a maximum of 87 working days in which to move 3,880 ft. of boardwalk, to deck 1,040 ft. of unmoved boardwalk, to demolish and reconstruct buildings, to place 210,000 cu.yd. of pumped sand fill and to complete about 170,000 cu. yd. of excavation and grading. It was imperative that the contractors adopt methods which would assure unusually rapid work.

Moving of the boardwalk was carried out under the supervision of E. W. Foley, Inc., of Brooklyn, N. Y., a contracting firm which became associated with the general contractors on this project. To remove and re-install concrete pile bents 40 ft. in width and 30 ft. in overall height, weighing 16 tons each, this contractor devised an ingenious hoisting and jetting apparatus which shifted the bents intact, in contrast with ordinary method, proposed by others, of cutting the cap beams free from the piles and handling the members separately.

Boardwalk

Width of the boardwalk is 80 ft., and the 40-ft. concrete bents are installed in double units to support this width. Each bent is made up of four 14-in. square piles 28 ft. long and a cap beam 2 ft. deep. Under the old boardwalk, bents were spaced 19 ft. 2 in., c. to c., but for the new walk the span length was reduced to 19 ft. to assure close fit of dapped timber floor stringers against the shoulders of the cap beams.

Creosoted 4x14-in. timber stringers, installed 46 to a full bay 80 ft. wide, were salvaged from the old walk and placed on the new structure. A crane-operated spider truss equipped with 40 swinging hooks moved and set the salvaged floor framing in 20x40-ft. sections. Ends of the stringers were dapped to fit the new span length. To compensate for irregular top surfaces of the cap beams on the bents, floor framing was adjusted to grade where necessary by putting creosoted wooden shims under the ends of the stringers. New di-

CONEY ISLAND'S SUMMER CROWDS (left) will have broader beach this year as result of boardwalk straightening which has moved walk average distance of 250 ft. inshore.

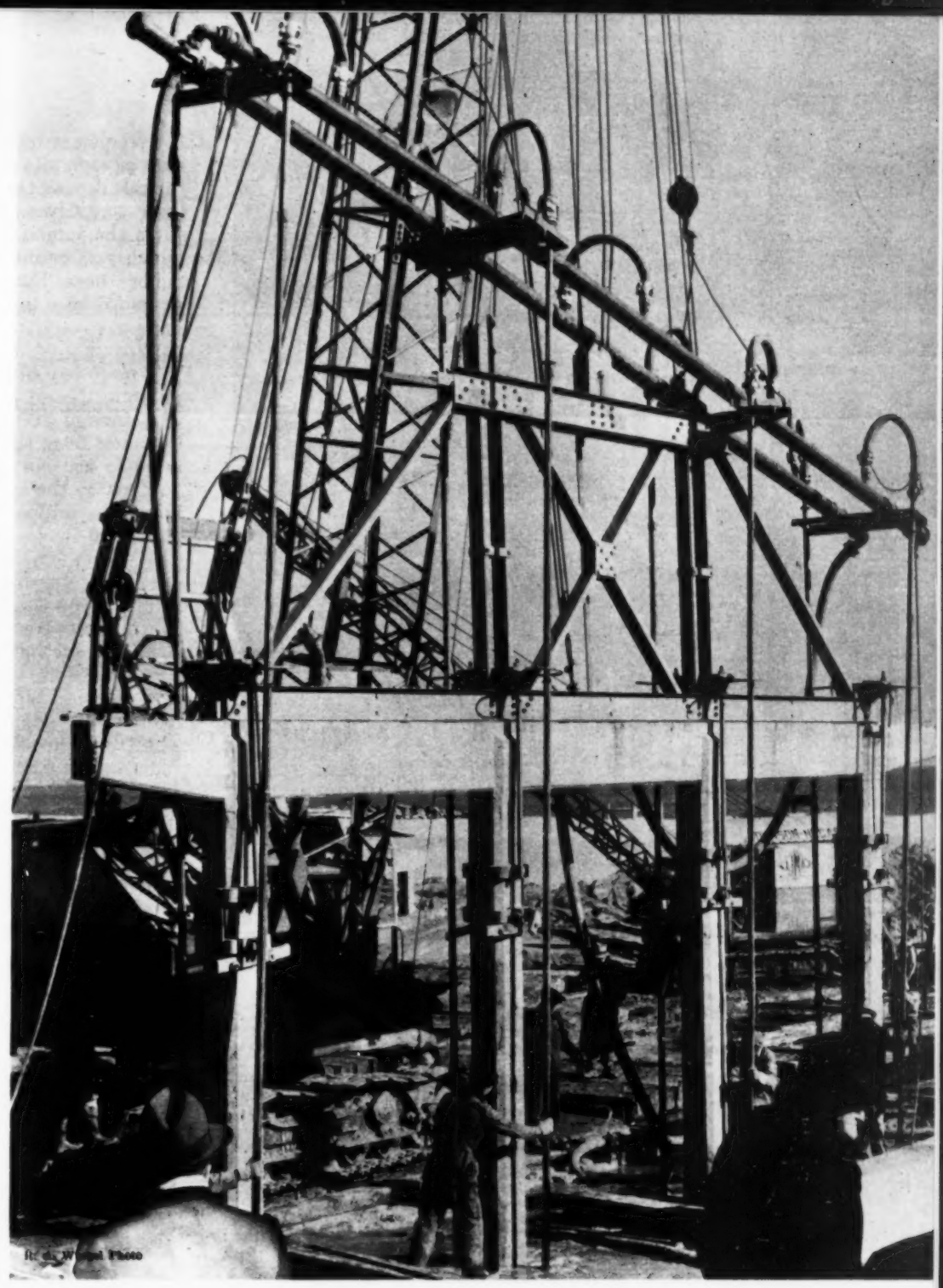
agonal flooring of 2x4-in. dressed Douglas fir was laid on the stringers.

To pull, transport and set the four-pile bents, the contractor utilized a so-called carrier beam hung from a 60-ft. boom on a Marion 2½-yd. convertible excavator with a boom lifting capacity of about 30 tons. The carrier beam really was a three-panel truss, 31 ft. long by 9 ft. 4 in. high, made up of bolted channels; the truss weighed 4 tons.

On the top chord of the truss were three double sheaves, spaced about 5 ft. apart, which operated on a semi-continuous line reeved to two drums of the crane. The line was ¾-in. wire rope to fit the drum grooves. Between a five-sheave block at the boom tip and the three double sheaves on the carrier beam, the line was reeved in accordance with an equalizing arrangement which maintained a level beam and gave ten parts of actual hoisting falls.

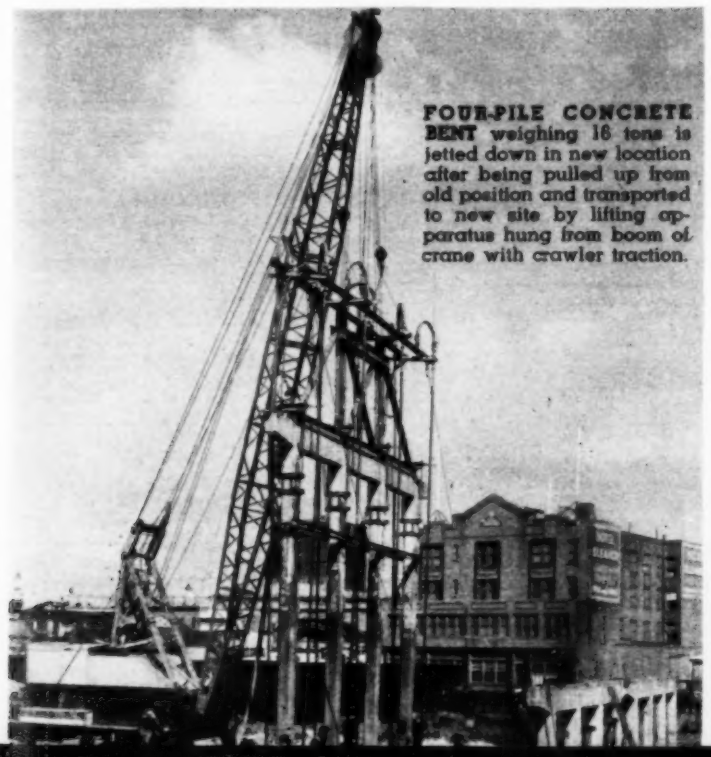
To pick up a bent, the carrier beam was centered on the cap, with the end points and intermediate panel points of the carrier truss spotted directly over the four piles. Short double channels resting on the lower chord of the truss at the panel points supported vertical eyerods which fastened to bolted clamps on the four concrete piles, as indicated by accompanying photographs. The eight eyerods, attached two to a pile, served to lift and carry a 16-ton bent. Because of a small building which was in the way, it was necessary to transport some bents almost 800 ft.

Jet Points — Essential to the operations of extracting and jetting the four-pile bents in the sandy beach was a battery of eight high-pressure jet points suspended from a jumbo header frame which was raised and lowered by two hand-winch-controlled lines running through sheaves on a special cross-arm attached to the crane boom at the tip. Each 2-in. jet point delivered 100 g.p.m. at a pressure of 100 lb. or greater. Guide rings at the ends of the short cross-channels on the carrier beam maintained

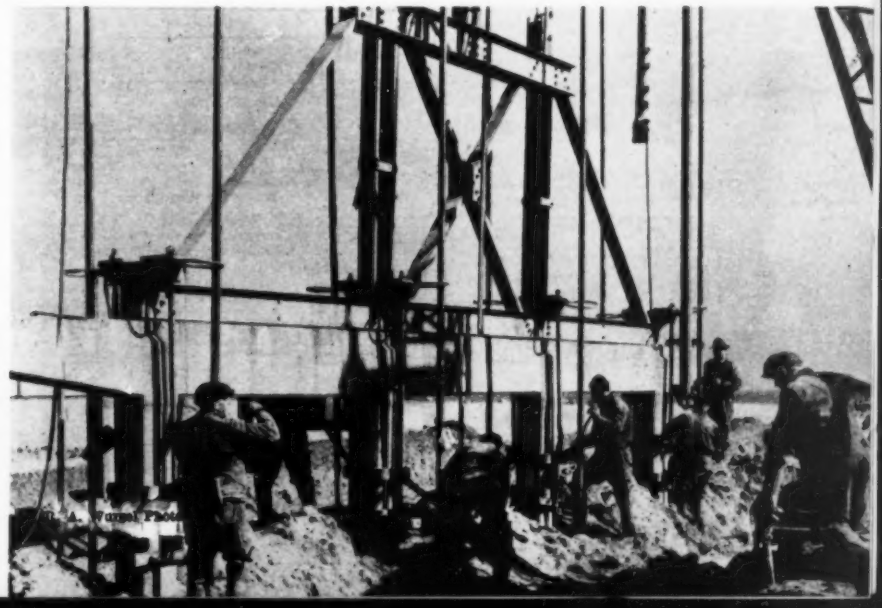


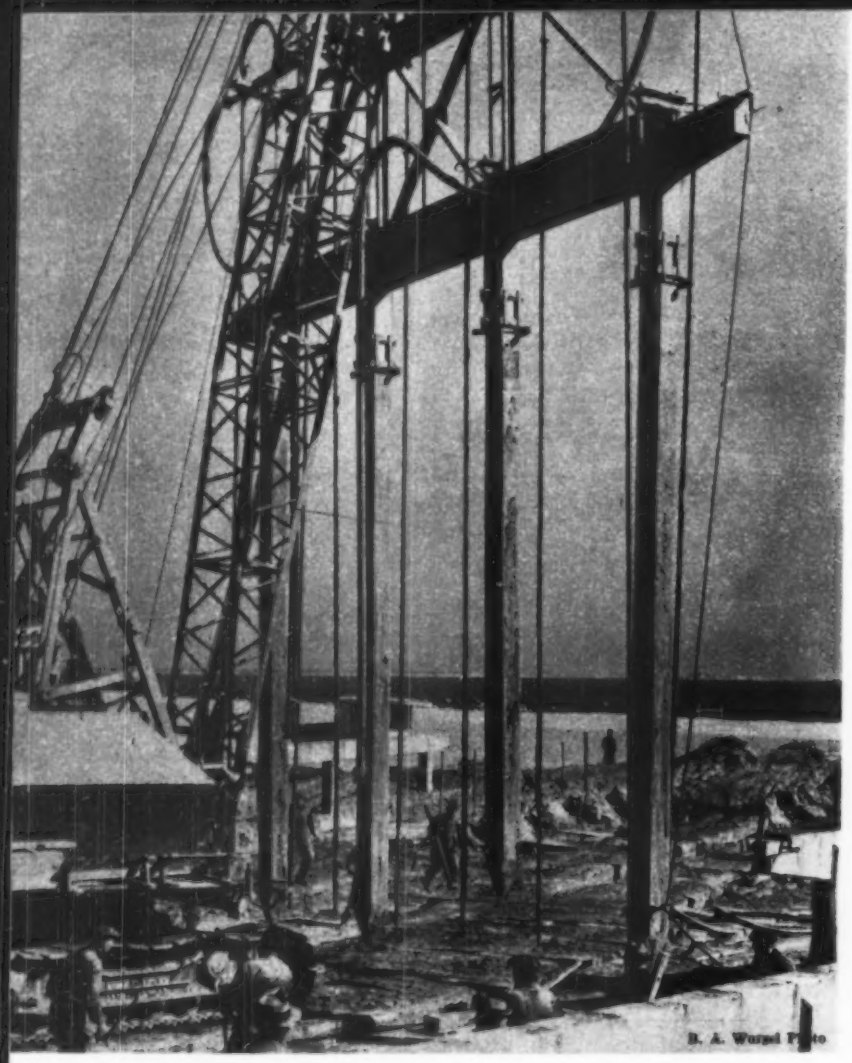
MANIPULATION OF JET PIPES (above) by workmen stationed at four piles assists jetting of concrete bent to grade at new location. Jetting jumbo operates independently of carrier truss.

IN PREPARATION FOR EXTRACTING CONCRETE BENT (below) from sand beach, workmen attach vertical eyerods of carrier beam to bolted clamps on four concrete piles. Man at right brings up one of hose connections which supply high-pressure streams to jet joints used in dislodging bent from sand.



FOUR-PILE CONCRETE BENT weighing 16 tons is jetted down in new location after being pulled up from old position and transported to new site by lifting apparatus hung from boom of crane with crawler traction.





IN TRANSIT TO NEW LOCATION, concrete bent hangs suspended from carrier beam while crane travels on double lines of timber mats.

the jet points in approximate vertical positions, and a workman at each pile rotated the two jet pipes on opposite sides of the pile during the jetting operation to assist them in working their way down through the sand.

On the jumbo frame were two 8-in. header pipes, each of which was connected to four jet points by short lengths of rubber hose. Each header pipe was connected by 3-in. high pressure hose to the pipe line on the ground.

Water Supply

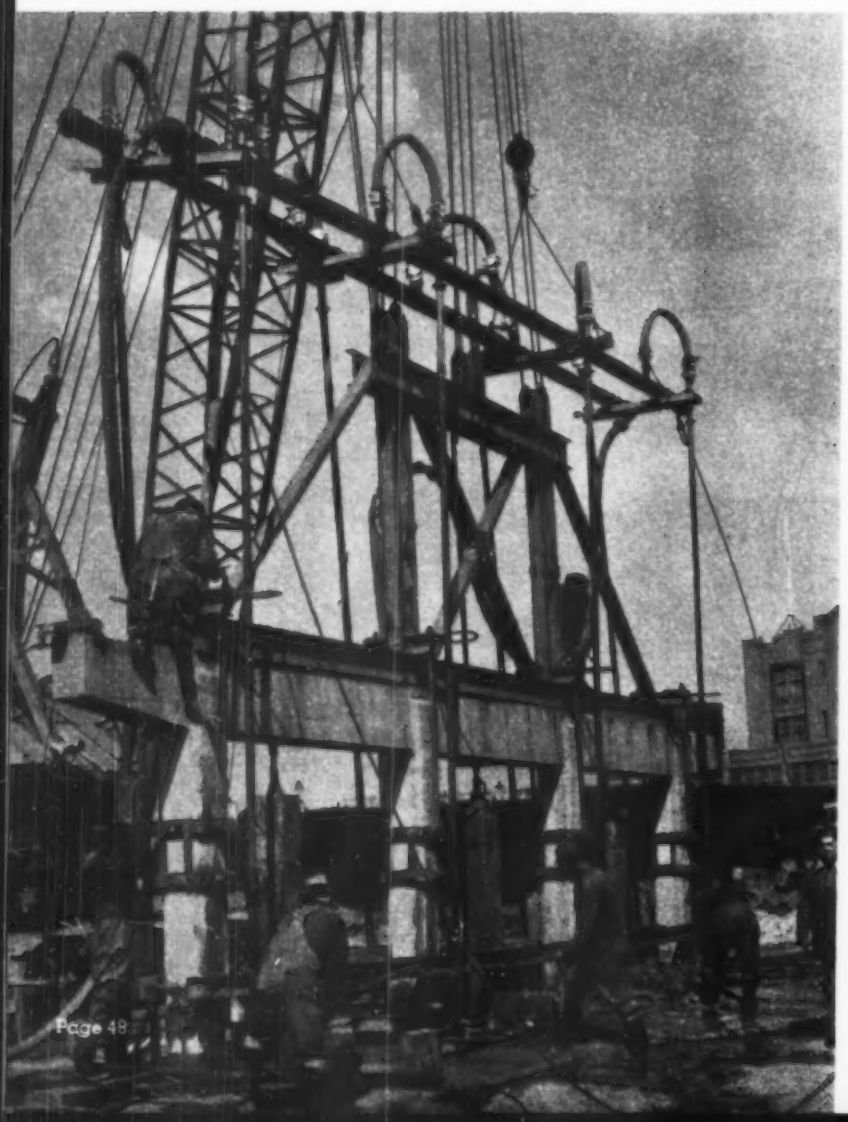
A major problem in successful jetting was the provision of pumping facilities which could supply 800 to 1,000 g.p.m. at pressures of 100 to 125 lb. per square inch. Water could not be taken from the ocean at any practicable distance offshore because the surf stirred up sand which would have been ruinous to the pumps. As an alternative, the contractor at about the midpoint of the job sank 150 Griffin 1½-in. wellpoints 20 ft. deep in the beach and installed three 8-in. suction points at shallow depth from an offshore jetty. A Griffin-equipped pumping station containing four suction pumps and four booster pumps pulled water from these points and built up the pressure to 125 lb.

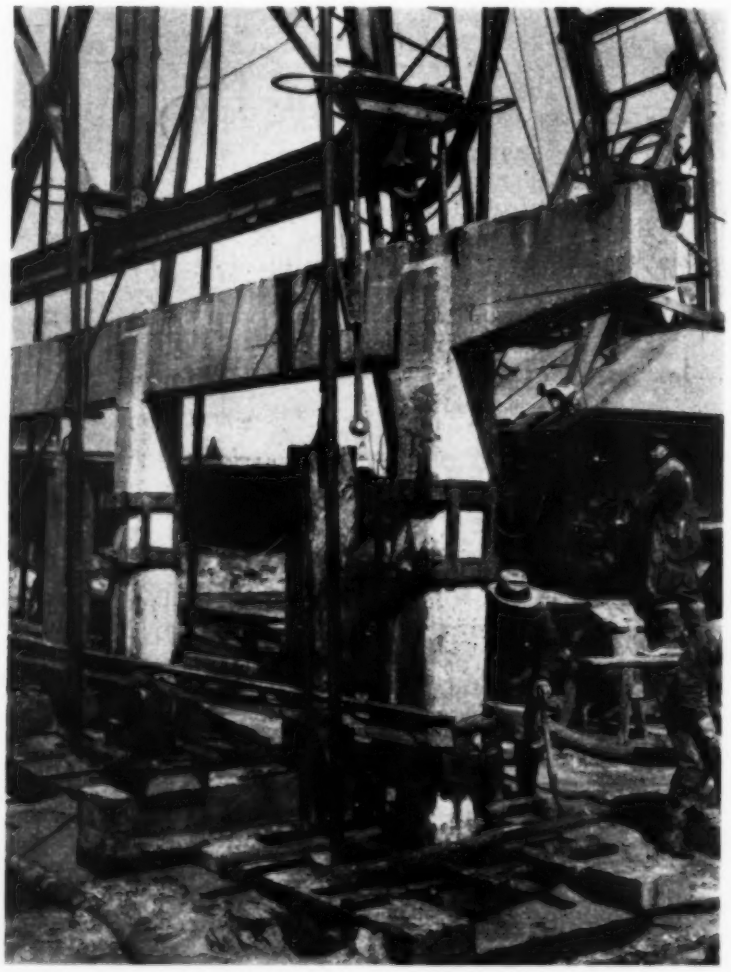
On the suction side, the pump battery comprised one 10-in. and three 6-in. centrifugal units. The discharge side consisted of one 8-in. and three 6-in. pumps, all four-stage units. A 10-in. pipe line was laid from the pumping station to the point where connection was made with the jetting apparatus. The maximum length of this line was about 2,000 ft.

Because of fine sand and loam in the soil below the surface of the beach, the pumps at times experienced difficulty in drawing a sufficient volume of water from the points. When jetting was not in progress, the pressure pumps were frequently used to clean the wellpoints by reversing the flow through them.

Administration—Improvement of the Coney Island beach-

WITH BENT JETTED TO GRADE (below), as indicated by jacks set up under cap beam to make final adjustment, workmen go up on top to loosen threaded eyerods.

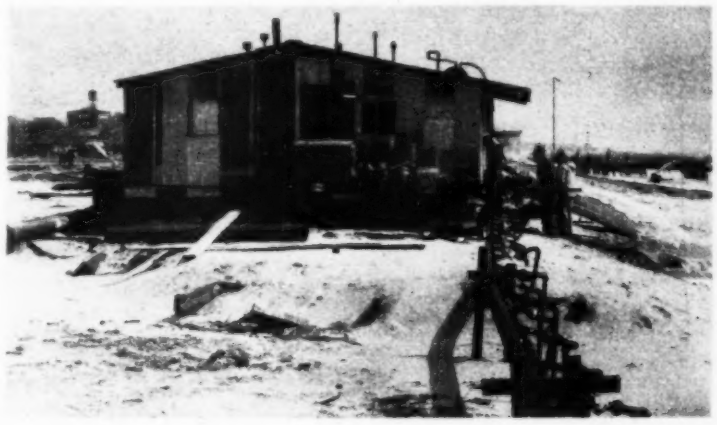




WITH EYERODS DETACHED from pile clamps, carrier beam is lifted clear of concrete bent. Wood strips nailed to heavy timbers aid spotting of piles in accurate position.

front is part of the general park betterment program initiated by Robert Moses, commissioner New York City Department of Parks. For the department, the work was directed by James A. Dawson, park director in charge of design, and John Mulcahy, resident engineer in charge of engineering and construction in the five boroughs, with Boni Liljeback as chief inspector at the site.

For the general contractors, The Arthur A. Johnson Corp. and Necaro Co., Inc., New York, the work was carried out under the personal supervision of Albert D. Saunders, vice-president of The Arthur A. Johnson Corp., Chester A. Leighton, job manager, and Wilbur C. Ring, job engineer. Work performed by E. W. Foley, Inc., Brooklyn, was executed under the personal direction of E. W. Foley, Sr., president, with Michael L. Dorsey, superintendent.

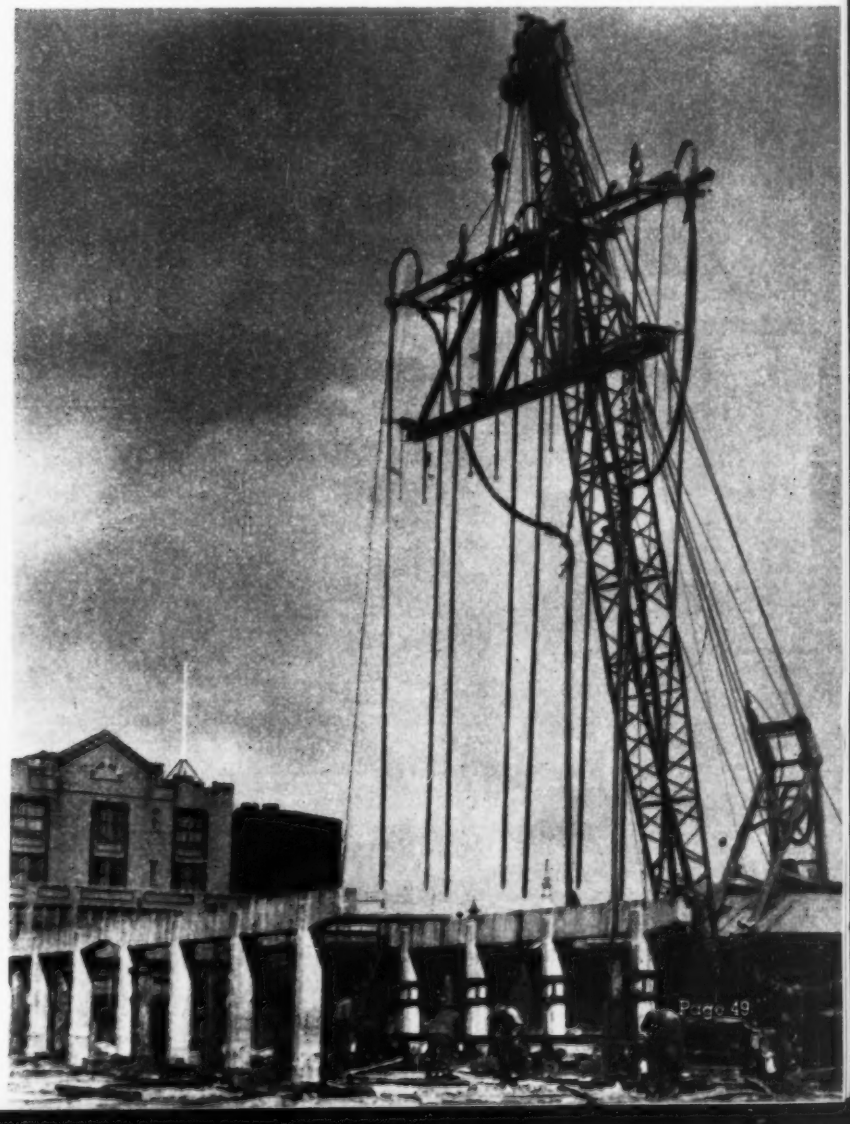


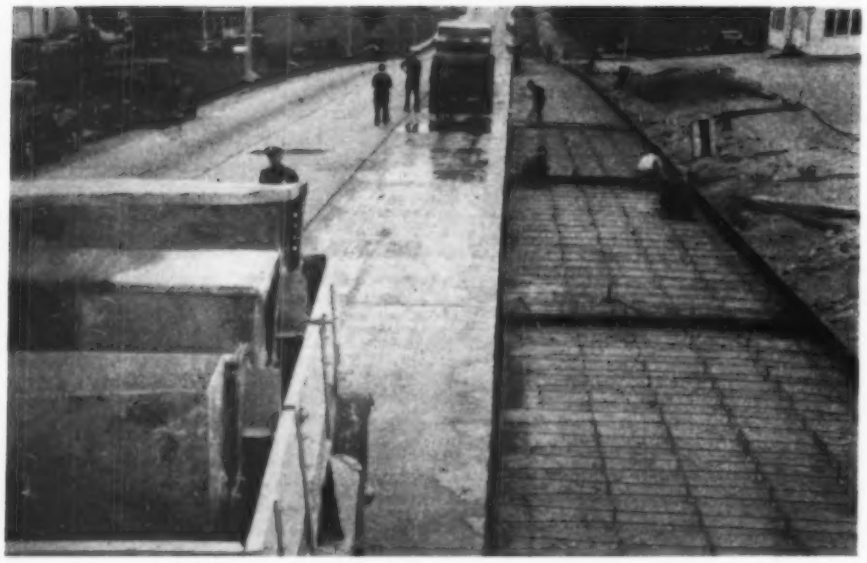
PUMPING STATION. comprising four suction pumps and four high-pressure discharge pumps, draws water from wellpoints and delivers it through 10-in. line at left to jetting apparatus.

SALVAGED FLOOR FRAMING is handled in 20x40-ft. sections by special carrier frame equipped with 40 swinging hooks for picking up stringers.

GEARED HAND WINCHES at two sides of crane operate hoisting lines which raise and lower jetting apparatus.

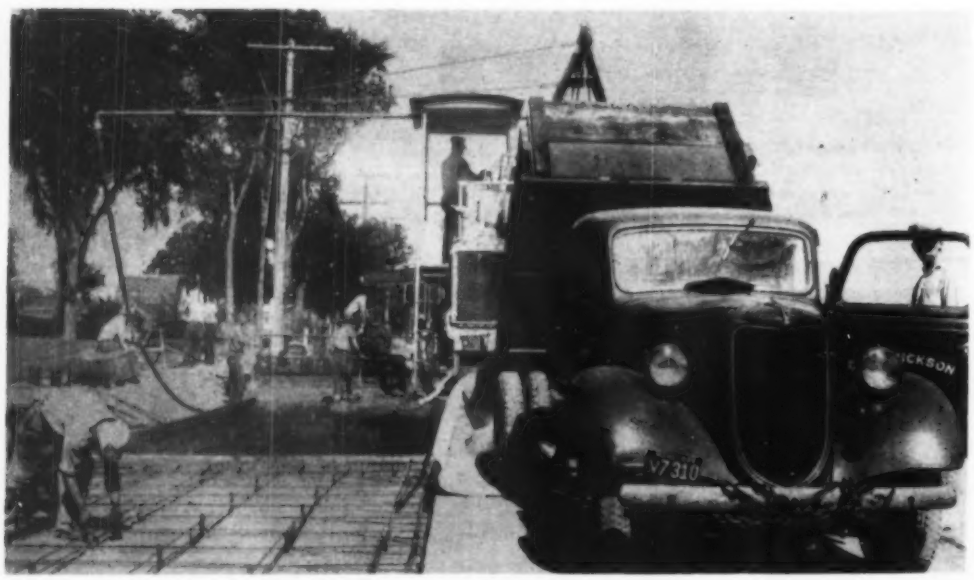
AFTER COMPLETING INSTALLATION of pile bent in new boardwalk location **(below)**, crane hoists carrier truss and jet points clear for transfer to next bent on moving schedule.





SEPARATE CONTAINERS carry bulk cement on batch trucks delivering materials for experimental widening strip, being prepared for paving at right.

CONCRETE CYLINDERS and beams are made each day, to be tested at stated intervals as a check upon strength of concrete in pavement.



DOUBLE STEEL MAT reinforces concrete slab on Maine experimental project. Paving mixer travels on existing slab alongside widening strip.

CONCRETE DEPOSITED ON SUBGRADE piles up in front of reciprocating screed on finishing machine. This concrete contains portland cement with 0.03 per cent vinsol resin.

Maine Tests Admixtures IN CONCRETE PAVEMENT

By **CHARLES F. PARKER**
Junior Engineer,
State Highway Commission,
Augusta, Maine

TO OBTAIN INFORMATION regarding the durability of portland cement concrete pavement with various admixtures, the Maine State Highway Commission last summer laid about 6 mi. of experimental concrete widening along U.S. No. 1, about 5½ mi. west of Portland, on a contract of the Lane Construction Corp., Meriden, Conn. Individual sections of the experimental project utilized admixtures consisting of natural cement or vinsol resin (the latter in two different percentages) in concrete mixtures with varying proportions of fine and coarse aggregate. Vinsol resin was ground with the portland cement at the mill; natural cement was added on the job..

All concrete mixtures had a cement factor of 6½ sacks per cubic yard. The three cement mixtures (used in concrete mixes containing varying percentages

UNIT WEIGHT DETERMINATION of concrete checks cement factor in mixture.

LONGITUDINAL FLOAT imparts good riding surface and closes up most of pits left after transverse screeding.

of fine and coarse aggregate) were: (1) portland cement with 0.03 per cent vinsol resin, (2) portland cement with 0.05 per cent vinsol resin, and (3) a mixture of 5½ parts portland cement to one part natural cement.

Because of its location, the project offers an exceptional opportunity for a study of concrete pavement durability. The road carries a good volume of year-round traffic, requiring winter maintenance and sanding. Temperature records show that a change of 50 deg. in 12 hr. occurs on the average about once a year, a change of 40 deg., about two or three times each year, and a change of 30 deg. in 12 hr. may occur as often as three or four times in one month.

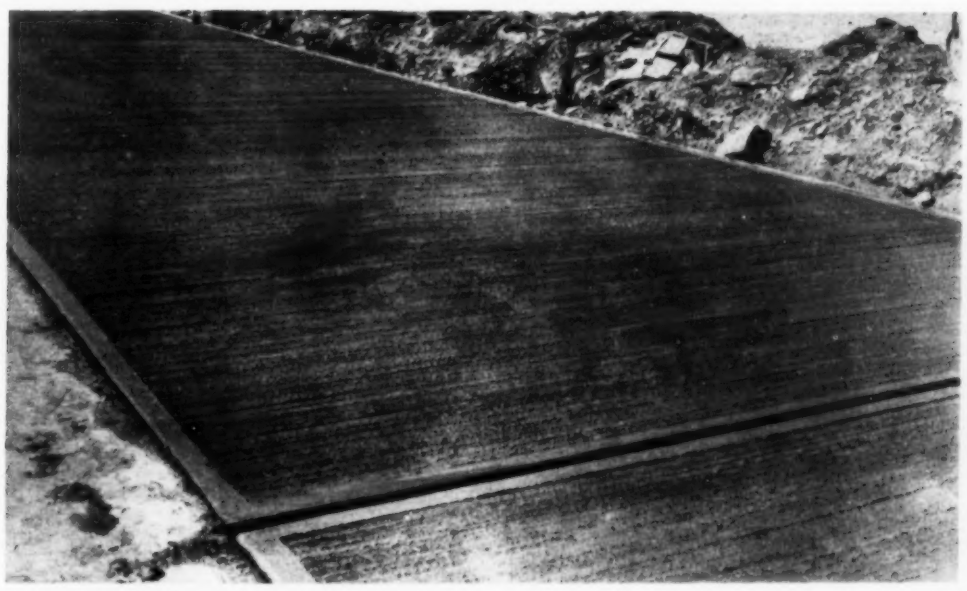
Concrete Aggregates—Four sizes of aggregate were used in the mix: 1¼ in. to 2 in., ¾ in. to 1¼ in., ¼ in. to ¾ in., and sand passing ¼ in. The coarse aggregate was crushed gravel. A field laboratory at the crushing, screening and washing plant maintained a constant check on the grading and quality of the aggregate.

Because the batching plant was equipped with only three bins and weighing batchers, it was necessary to mix the two largest sizes of aggregate volumetrically before placing them in one bin. Stockpiling of sand was of utmost importance in the control of the mixtures. Moisture tests of both fine and coarse aggregates were made at regular intervals by the Pycnometer method, and the batch weights were corrected accordingly. Mixing water was analyzed

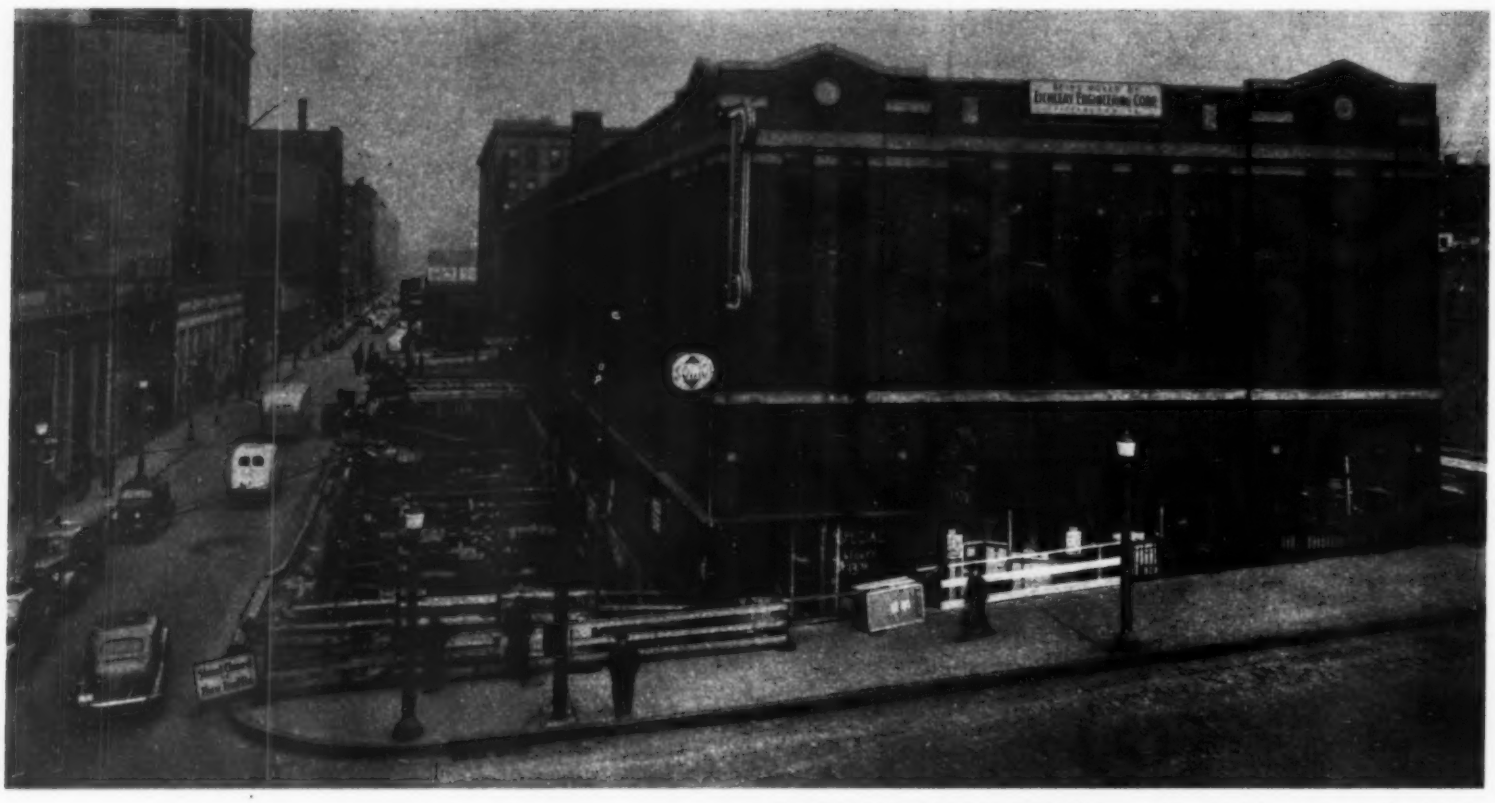
(Continued on page 100)

SPLIT FLOAT straddles joint caps at transverse expansion joints

TRANSVERSE EXPANSION JOINT is finished against cap.



BROOMED FINISH leaves roughened surface which reduces danger of skidding and glare. Completed transverse joint appears in foreground.



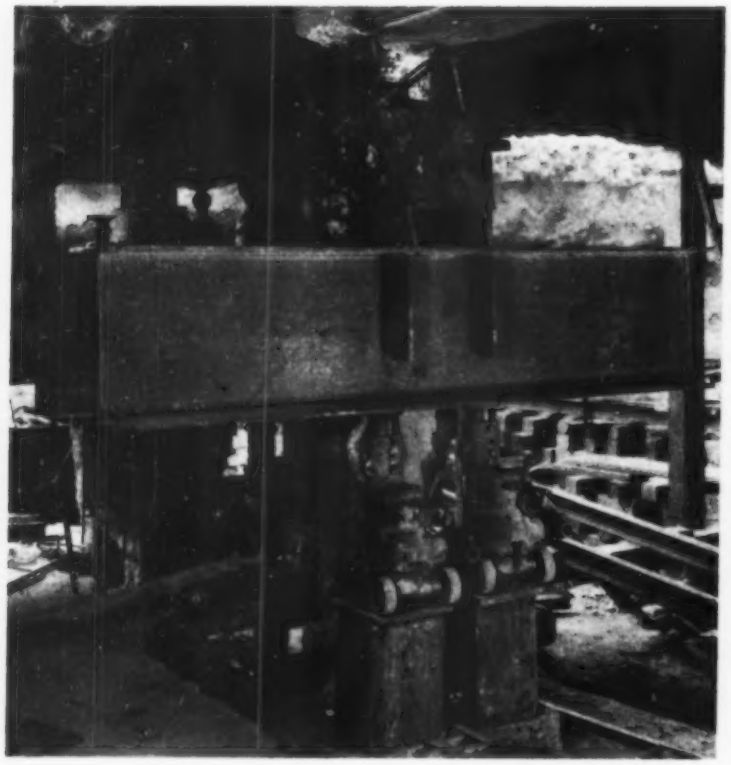
BLOCK-LONG GARAGE BUILDING weighing 10,000 tons moves back 27 ft. to permit widening of Commerce St. in Youngstown, Ohio.

10,000-Ton Building

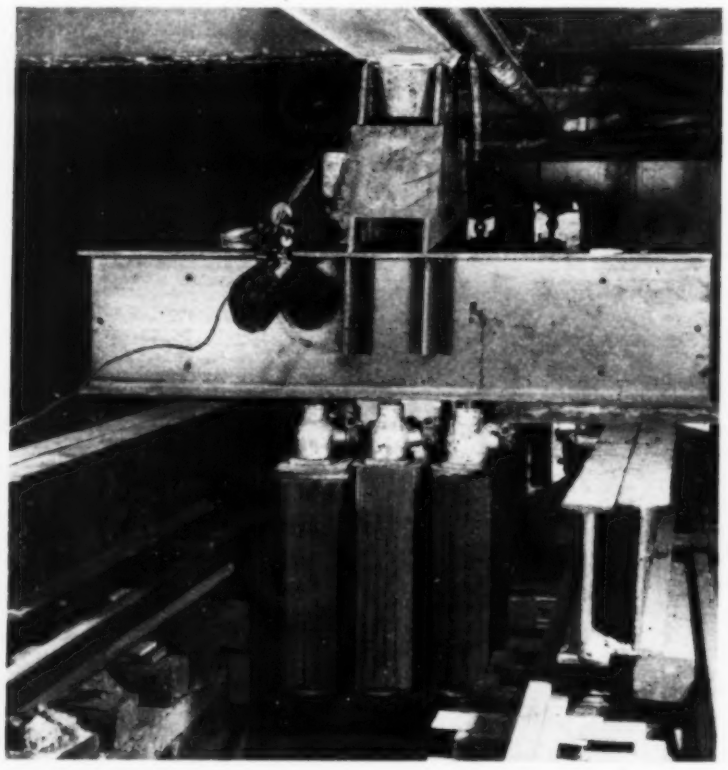
SIDE-STEPS

STREET WIDENING

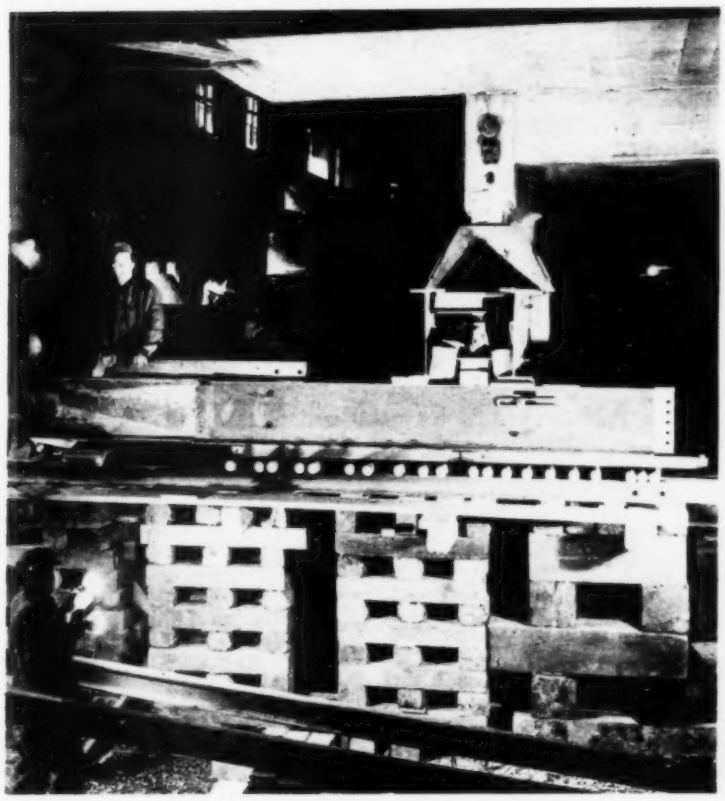
TO MAKE WAY FOR THE WIDENING of Commerce St., Youngstown, Ohio, the Eichleay Engineering Corp., contractor, of Pittsburgh, Pa., jacked up the 10,000-ton Central Square Garage building, a four-story steel-frame structure 327 ft. long by 65 ft. wide, and rolled it back to new foundation 27 ft. from its original location. By means of steel brackets welded in the basement to the 66 steel columns of the building, the contractor picked up the column loads, ranging from 100 to 325 tons per column, on needle beams and transferred these loads to runner beams resting on solid steel rollers on steel rail tracks. With all the columns thus supported, screw jacks were employed to exert horizontal pressure against the



HEAVY-DUTY JACKS pick up columns supported by welded steel brackets on wide-flange steel needle beams.



RUNNER BEAMS are installed on roller tracks under two ends of needle beams. Rollers are solid steel, 3 in. in diameter.



OVER STEEL-RAIL TRACKS supported by timber cribbing, columns are rolled 27 ft. to new foundations. Roller shoes made up of 12-in. steel channels with hardwood fillers support runner beams on rollers.

DURING MOVING OPERATION jacks used for shoving operate against timbers braced back to sheeted bank along old street frontage. Connecting bridges are kept in service to permit automobiles to use garage.

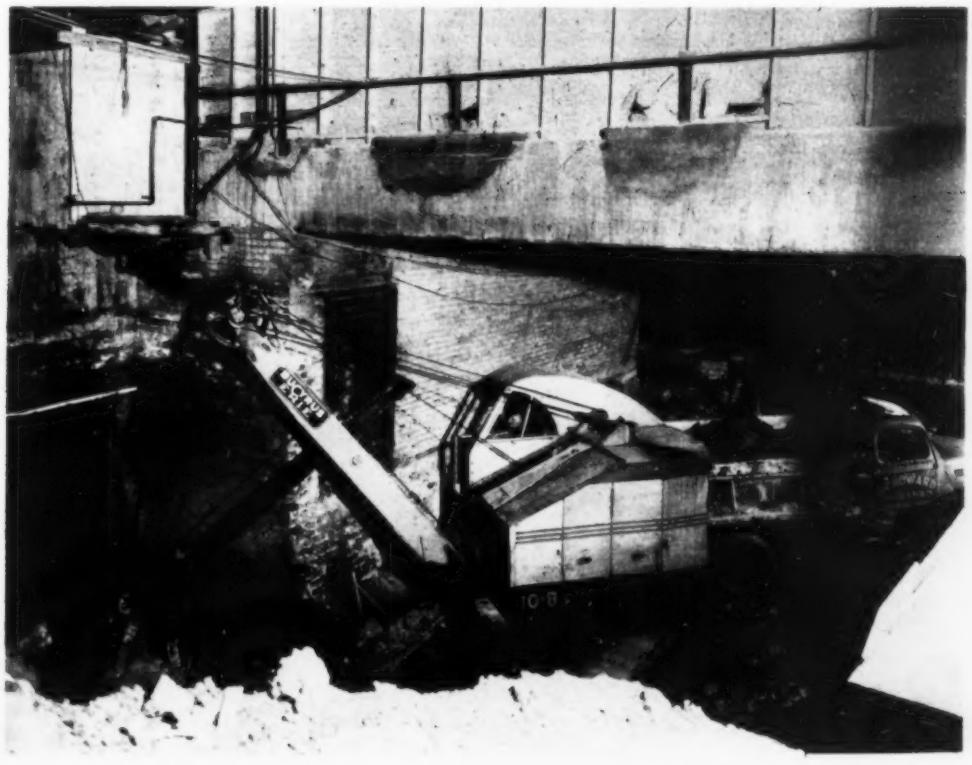
front of the building, moving the structure backward by short successive shoves to its final position in a brief working period.

After inserting the needle beams under the welded brackets, workmen raised each column 5/8 in. on heavy-duty jacks of 50- to 100-ton capacity. Steel rollers, channel roller shoes and runner beams then were placed on the two lines of steel rails under each end of the needle beams, and the jacks lowered the column 1/8 in. to transfer the load to the needle beams, leaving 1/2-in. clearance for moving. The tracks rested on timber cribbing, and trenches were excavated to provide passageway for the columns during movement.

With all preparations completed, the movers pushed the building backward on the roller tracks at a steady uniform rate by jacking with 30 ratchet-type 5-ton screw jacks against timbers which were end-braced to a sheeted bank on the old street front. Jack operators worked in unison on signal from the foreman. Once jacking had begun, the actual moving of the 10,000-ton building took only 15 working hours, the aver-

(Continued on page 86)

STEEL BRACKETS to transfer column load to needle beams are arc-welded to flanges of H-column in basement.

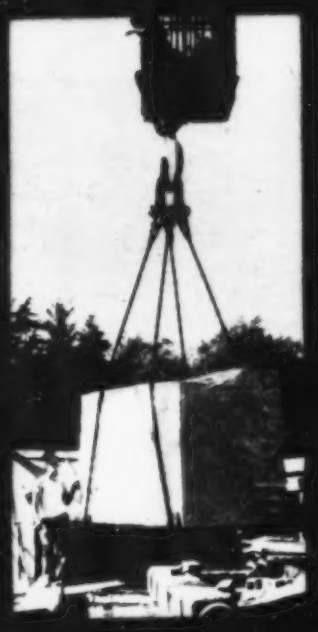


NEW BOILER ROOM LOCATION is excavated in basement by power shovel. Total of 7,000 cu.yd. of excavation is involved in preparations for moving building.

WIRE ROPE SLINGS IN USE

EQUALIZING SLING with anchor hook and ends fastened by wire rope clips handles 42-ton concrete pipe section for Tacoma's new water supply.

25-TON GRANITE BLOCK (below) is handled with 8-par braided wire rope sling (Macwhyte).



FOUR-LEG BRIDLE SLING and crane raise heavy motor truck at Gentersville dam, a Tennessee Valley Authority project.

BRAIDED SLING (Macwhyte), designed for handling heavy loads, is equipped with anchor hooks and whip slings that cradle load.

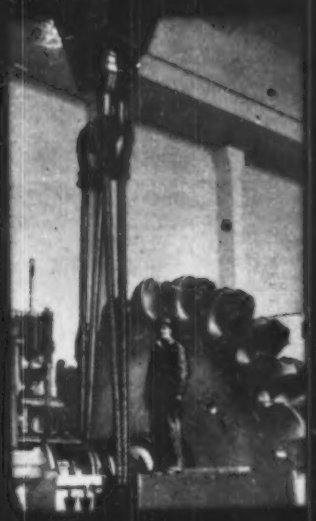
THREE WAY SPECIAL wire rope (Macwhyte) (below) having eyes fitted with thimbles handles wheelborrow loaded with brick on industrial building job.

SPECIAL SLING RIG is employed to lower 10-ton, 120-ft. long section of subaqueous pipe line in San Francisco Bay.

PADDING ON EDGES OF LOAD helps prevent cutting of pair of grommet slings. Both slings are 3/4 in. improved plow steel (Roebling).

THREE GROMMET SLINGS of 3/4 in. wire rope (Roebling) lower 84-in. diameter, 24-ton section of cast iron pipe line.

HEAVY TURBINE SHAFT (below) and rotor are removed from setting by two-part equalizing sling (Broderick & Bascom).



HOW TO SELECT AND USE *Wire Rope Slings*

By W. ELWOOD ROSSNAGEL
Safety Engineer, Consolidated Edison Co. of New York, Inc.

ADEQUATE CONSIDERATION may be given by the designing engineer to the choice and installation of component parts of hoisting tackle on a crane or derrick, including hoisting cables, their attachments, sheaves, pins, blocks and hooks, but his effort may be largely nullified if the riggers who eventually operate the equipment use improper slings or use proper slings in an incorrect manner.

Manila rope and iron and steel chains have been largely superseded by steel wire rope for the hoisting tackle on such equipment, with resultant increase in safety and with the ability to lift much greater loads. It must be kept in mind that manila rope and chain both have their proper places on rigging jobs, the former being used for lifting comparatively light loads and on temporary work, while chains have been universally adopted for infrequent service and light loads, as for example on the familiar chain hoist. But on permanent installation and in heavy-duty operations they have their limitations. Manila rope deteriorates rapidly when exposed to the weather, and after such exposure it is very difficult to estimate its actual strength.

Chain has much greater resistance to the effects of exposure to the elements, but has other shortcomings. In hand-forged chains there is ever present the human factor in the form of the welder who may or may not have made a perfect weld. Electrically welded steel chain is considerably more uniform in quality, but even its safety depends upon the proverbial "weakest link," as the failure of any one link will cause the load to drop.

Wire hoisting rope, on the other hand, is usually 6x19 Warrington construction — that is, it consists of 6 strands, each containing 19 wires, twisted or laid around a hemp rope center. Unlike the chain, failure of one of the component parts, a wire, will result in a reduction in strength of less than 1 per cent, which is insignificant. This is the primary reason that wire rope has been almost universally adopted for cranes and derricks. But properly designing a piece of hoisting equipment to lift safely a given load on the hook is not the only problem. That load must be secured to the hook, and the attachment must be of adequate strength to lift the load safely. Thus is presented the problem of properly designing and using slings, the subject of this article.

Types of Sling

Just as in the case of hoisting tackle, various materials may be used for slings. For the very lightest loads an endless manila rope, looped into a noose around the object to be lifted, is satisfactory. Such a sling is inexpensive, of light weight, flexible and easy to handle. It can be bent around the comparatively sharp edges of boxes or crates, but should be padded when passing over the sharp machined edges of metal parts. Even on some heavier jobs, such as handling of shafts which must not be scratched or burred, manila rope slings have found favor.

Coil chains have limited application as slings, being used principally for light loads or where exposed to heat, as in foundries. Like manila rope, a chain should be heavily padded where it bears on sharp edges of metal parts; otherwise, some of the links may be subjected to severe bending stress for which they were not designed. Also, the chain may bruise or otherwise damage the edges of the piece being lifted.

For special work slings are sometimes made of other materials, such as roller chains, leather, and cotton webbing, but by far the greatest number of slings in use today are of wire rope. From the safety viewpoint wire-rope slings possess the same points of superiority as do wire ropes for hoisting tackle, mentioned above. But even wire-rope slings must be carefully chosen for the service in which they are to be placed, as they

SAFE LOADS ON SLINGS IN TONS

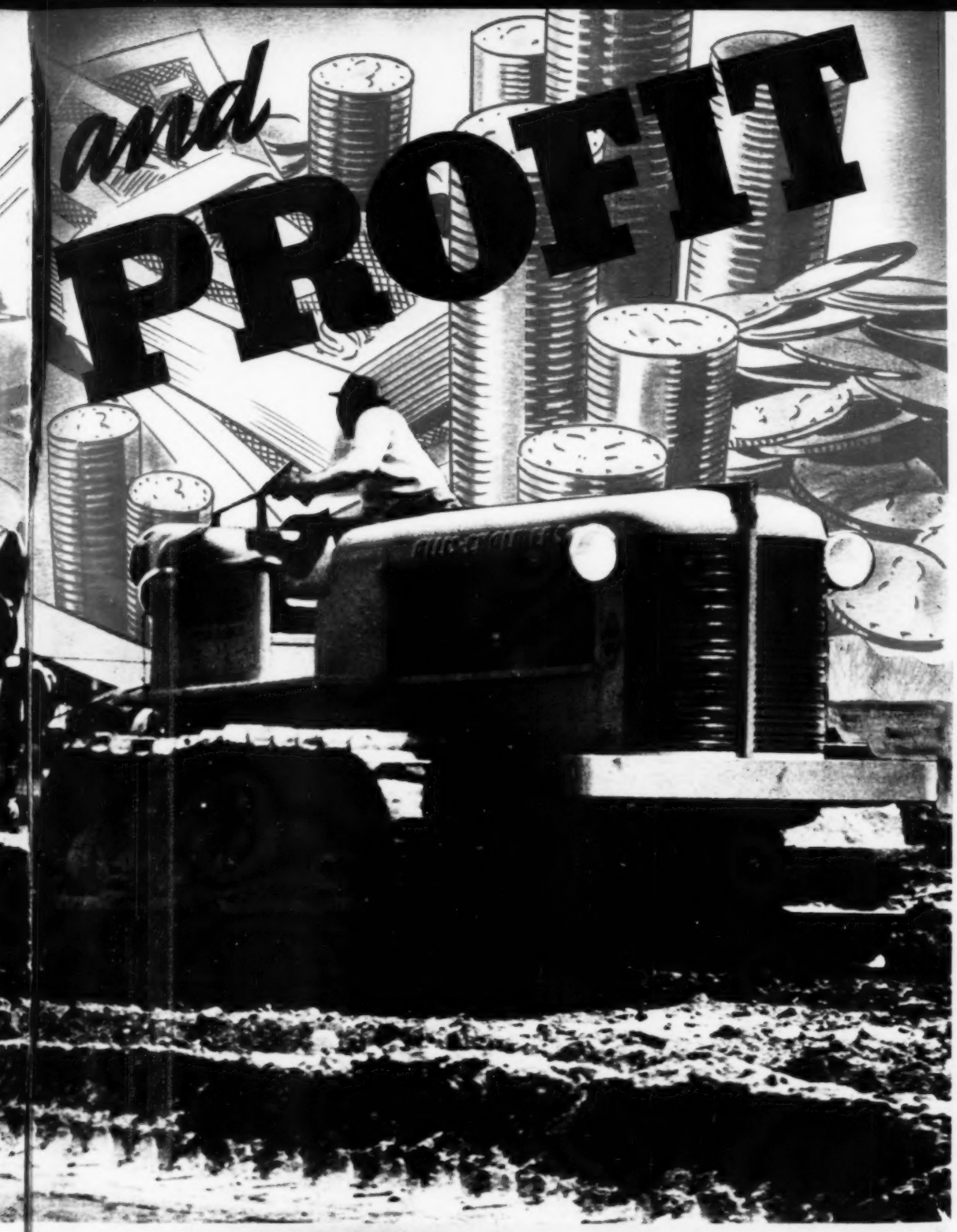
6x19 PLOW STEEL ROPE							IRON COIL CHAIN							8-PART BRAIDED SLING (ATLAS)						
Rope Diam., In.	Single Leg Vertical	2-LEG SLINGS			Basket Hitch	Weight per Ft., lb.	Stock Diam., In.	Single Leg Vertical	2-LEG SLINGS			Basket Hitch	Weight per Ft., lb.	Dia. of Rope Used, In.	Single Leg Vertical	2-LEG SLINGS			Basket Hitch	Weight per Ft., lb.
		60°	45°	30°					60°	45°	30°					60°	45°	30°		
3/8	1.20	2.08	1.70	1.20	1.70	.23	3/8	.90	1.56	1.28	.90	1.28	1.67	1/8	.77	1.34	1.10	.77	1.10	.18
1/2	2.05	3.55	2.90	2.05	2.90	.40	1/2	1.50	2.60	2.14	1.50	2.14	2.80	3/16	1.71	2.96	2.42	1.71	2.42	.42
5/8	3.15	5.46	4.45	3.15	4.45	.63	5/8	2.31	4.02	3.28	2.31	3.28	4.40	1/4	3.25	5.63	4.60	3.25	4.60	.80
3/4	4.50	7.79	6.36	4.50	6.36	.90	3/4	3.38	5.88	4.80	3.38	4.80	6.25	5/16	5.04	8.73	7.13	5.04	7.13	1.28
7/8	5.67	9.82	8.02	5.67	8.02	1.23	7/8	4.67	8.12	6.64	4.67	6.64	8.30	3/8	7.06	12.23	9.98	7.06	9.98	1.84
1	7.39	12.80	10.45	7.39	10.45	1.60	1	6.20	10.80	8.80	6.20	8.80	10.65	7/16	9.41	16.30	13.31	9.41	13.31	2.48
1 1/8	8.18	14.17	11.57	8.18	11.57	1.96	1 1/8	7.80	13.58	11.08	7.80	11.08	13.25	1/2	12.10	20.96	17.11	12.10	17.11	3.20
1 1/4	10.09	17.48	14.27	10.09	14.27	2.42	1 1/4	9.60	16.70	13.62	9.60	13.62	16.25	9/16	15.12	26.19	12.38	15.12	21.38	4.08

NOTES: Figures from Macwhyte Co., Kenosha, Wis.
Angles given are between legs of sling and the horizontal.
For 3-leg and 4-leg slings, multiply loads given for 2-leg slings by 1½ and 2 respectively. Factors of safety of 5 used in above tables.

ROLL UP MORE PROFITS. **Pulling and pushing with HD-14's you load as much as 50% extra material. You haul those big loads faster — gain 2 to 3 extra round trips hourly on a 600-foot haul ... additional trips gained as haul increases, practically doubling profitable haul distances. This fastest, most powerful tractor in the world travels up to 7 M.P.H. ... 108 DRAWBAR H.P. Does more work ... does it for less. See its extra profit-making advantages listed at right. Your Allis-Chalmers dealer will gladly prove to you ... NOW ... how this FASTER DIESEL POWER can add to your profits.**

☆ MAKE YOUR PR

Complete your fleet with an HD-14 pusher. Carry extra yards in your present scrapers — pack in more material and pile it higher ... cut loading distance, shorten loading time. Lightning pickup, remarkable flexibility, higher traveling speeds make the HD-14 an ideal pusher. Use it, too, as an auxiliary tractor — for bulldozing, clearing or pulling your blade, ripper and sheep-foot roller. You'll find it the most profitable investment you ever made.



DOUBLE THE POWER

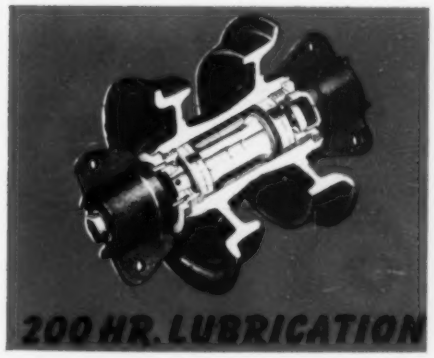
With the General Motors 2-cycle Diesel engine you get twice as much power as a 4-cycle Diesel with the same number of cylinders, bore and stroke. There are no waste strokes — every down stroke is a *power* stroke. There are no expensive, complicated parts. It's remarkably simple. The 2-cycle Diesel starts instantly, delivers more power per pound of weight — smooth, vibrationless power — at lower operating and maintenance cost.

NO ANTE FOR EXTRAS

HD-14 is completely equipped — no extras to buy. Standard equipment includes electric starter, lights, muffler, radiator guard, crankcase guard, front pull hook, bumper, hour meter, radiator shutters, fenders and heavy truck wheel guards.

LONGER WEAR BRAKES AND CLUTCHES

Velvetouch bi-metallic brakes and clutches — toughest, longest wearing you've ever had. Outlast ordinary brakes and clutches several times over in hard going.

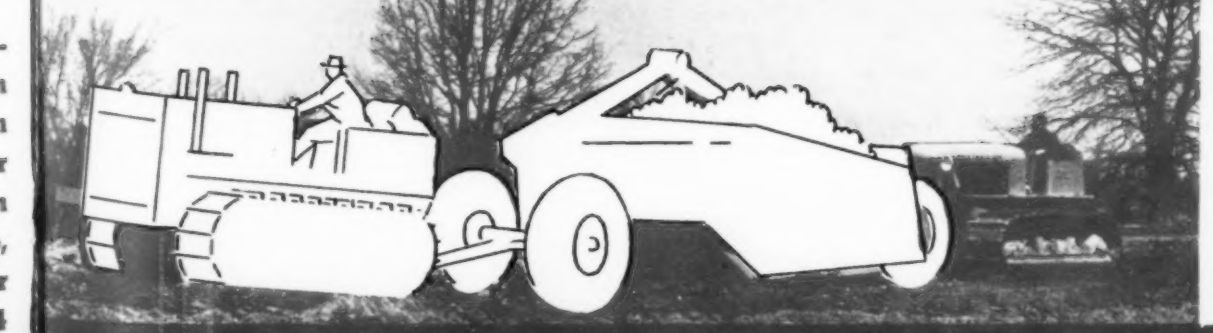


A lubricating oil . . . not grease . . . lubricates Allis-Chalmers Positive-Seal truck wheels and idlers. Once in 200 hours you simply flush out the old oil with new oil. You're absolutely protected against dirt, sand, mud or other destructive material entering the bearings . . . protected against costly delays . . . against high repair and lubricant bills. You gain ½ hour every shift.

LONGER TRACK LIFE

NEW SHOCK ABSORBER TRACK RELEASE — another A-C exclusive feature to guard you against delays . . . to lengthen your tractor life and lower its upkeep cost. Automatically eases strain when stones or other objects get in tracks.

PRESENT FLEET PROFITABLE!



ALLIS-CHALMERS

TRACTOR DIVISION — MILWAUKEE, U.S.A.

Faster DIESEL POWER

also have certain limitations. Like manila rope and chain slings, wire-rope slings should be padded where they are bent over sharp edges of the object to be lifted. Even though the edge is of soft material such as a wood crate or skid which will not cut the sling, nevertheless the individual wires are bent sharply and are highly stressed, possibly beyond the elastic limit, even before the live load is applied.

Wire-rope slings must not be allowed to become kinked, as this causes high bending stress. Then, too, the strands which have been displaced are subject to unequal distribution of the live load, some strands taking several times their normal load in addition to the stress produced by the sharp bending. Even though an attempt is made to remove a kink, the damage done to the rope is usually permanent. This accounts for many sling failures. Most wire-rope slings, like hoisting cables, are of 6x19 construction and of plow steel or improved plow steel grade, but the very large sizes are often made of 6x37 or 6x6x19 construction to increase the flexibility. All slings which, at one time or another, have been bent sharply become "cranky"—that is, they have developed permanent deflections, so that when the strain is relieved they snarl up in some unpredictable manner. This is annoying, to say the least, and it means continual vigilance to keep them from developing kinks when taking a strain preparatory to lifting a load. Slings made of preformed rope behave somewhat better than those made in the regular manner, and also have the advantage that broken wires will not "wicker out" and present a hand hazard to the rigger, but rather lie "dead" in the original position.

Variety of Designs

The term "sling" includes a wide variety of designs. Perhaps the simplest is the grommet or endless type (Fig. 1) which is made by using six complete loops of a single strand, it being laid or twisted around itself on each successive loop. The ends then are tucked into the space where a short length of the hemp center has been removed, such as is done in making a long splice. This type of sling usually is formed into a noose known as a choker hitch or anchor hitch which is slipped around the object to be lifted, and the free bight placed on the crane or derrick hook. When a strain is taken on the sling, it crowds in and squeezes the load, but to assure a firm grip it is good practice to strike the bight which bears on the hauling part with a block of wood so as to make three 120-deg. angles between the component parts at the bight. Slings of this type are sometimes made with the bights threaded through drop-forged thimbles (Fig. 2) which reduce the wear on the strands and at the same time keep the rope from being bent too sharply.

Another simple type is the straight rope with a spliced eye at each end, either with or without thimbles in these eyes. Such slings are generally used in making the "U" or basket type hitch (Fig. 3), and are almost always used in pairs. By passing one eye through the other a choker hitch may be made.

Straight slings also are made with a combination of rings, hooks, open or closed sockets, etc., on the ends (Fig. 4). When used in pairs, these slings are attached to eyebolts or lifting lugs on the object to be lifted, or both ends may be attached to the crane hook so as to form a basket hitch, or it may be used to make a choker hitch.

It is not necessary for these straight slings to be limited to one part of wire rope. The cable may be arranged with two, three, four, five or even six parts by passing around equalizing thimbles at each end of the sling (Fig. 5). In such slings, the ends of the rope may be socketed into the special thimbles, or the rope may be of endless or grommet construction.

Slings for Load Lifting

For lifting loads, such as large pipes, a two-leg bridle sling is frequently used, consisting of either two straight slings having thimbles or rings at the rubber end and hooks at the lower end (Fig. 4) which are engaged into the ends of the pipe, or a single sling having hooks at the two ends and an equalizing thimble at the middle (Fig. 6), which is attached to the derrick hook.

As larger loads are encountered, slings having three or four legs are used. These are equipped with hooks or eyes according to the type of load to be handled (Fig. 7). There are an unlimited number of possible designs for sling terminals, such as special clamps for handling steel plates flatways and those for handling plates in a vertical plane. For lifting foundry flasks special flat plates bent into the form of a hook (Fig. 7a) are used, since it is considered bad practice to pick up any load on the bill or point of an ordinary hook. For railroad wrecking crane service a large number of special shape hooks are used, each designed for ready attachment to a particular part of a locomotive or car.

For handling barrels or drums it is customary to use a sling with both ends attached to the crane hook by means of spliced eyes and a ring, and with two special bent plate hooks floating on the

(Continued on page 88)

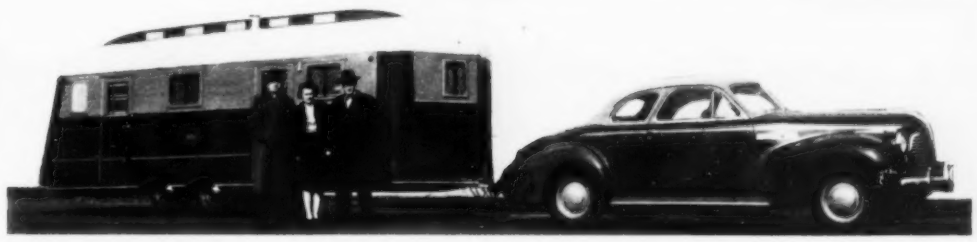
Figs. 1-10 . . . **TYPES OF WIRE-ROPE SLINGS AND FITTINGS:** **(1)** Grommet or endless sling. **(2)** Drop-forged thimble. **(3)** Spliced eyes for basket type hitch. **(4)** Straight sling with hook. **(5)** Three parts of wire rope in sling with equalizing thimbles. **(6)** Two-leg bridle sling with hooks and equalizing thimble. **(7)** Three-leg sling with hooks. **(7a)** Flat plate hook. **(8)** Barrel or box sling with pointed bent plate and grab-hooks floating on bight of rope. **(9)** Bar sling with turnbuckles. **(10)** Hook connection made by hydraulic press.

JOB oddities

CRADLED AT COULEE DAM. Construction-minded cat selected top of U. S. Bureau of Reclamation structure across Columbia River in Washington, where concrete placement is in active progress by Consolidated Builders, Inc., as setting for her accouchement, with resultant litter of kittens pictured herewith in arms of member of construction force.

DOUBLE HEADER in form of two sections of heavy steel pipe for high pressure line on slopes of Pike's Peak to serve Colorado Springs, Colo., is handled by 20-ft. boom rigged on tractor of Ed. H. Honnen Construction Co.

IMPROVISED SKIPS (right), made from halves of steel boiler shells salvaged from basement are used by Cleveland Wrecking Co. for handling scrap metal and other material during the demolition of Great Northern hotel in Chicago.



DELUXE TRAILER serves as home on wheels for Max Kuney, Jr., (at right) president of construction company that bears his name, who is engaged on a road-building and bridge project in Missoula, Mont. Trimmed in mahogany, this Indian trailer is 27 ft. long and includes 10-ft. living room with built-in desk, bedroom, galley and white-tiled shower. Exterior is of Masonite colored green to match Mr. Kuney's pilot car, a 1940 Buick coupe.

ALL-STEEL WELDED CONSTRUCTION of special pressed panels is feature of new 132x284-ft. plant addition at Peoria, Ill., of R. G. Le Tourneau, Inc., makers of heavy-duty earth-moving equipment, typified by Carryall scraper outfit in foreground. Flat roof of warehouse and stockroom structure is supported by twenty-one 18-in. round columns each equipped with a 2-ton jib crane for handling machinery and materials.

HOW They Did It

CONSTRUCTION DETAILS

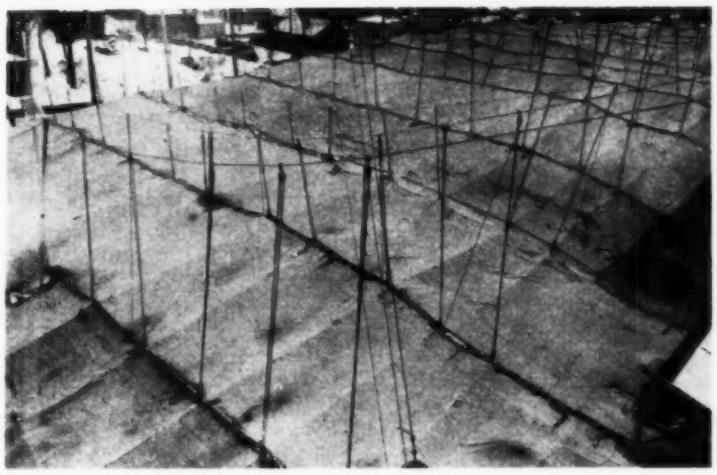
For Superintendents and Foremen

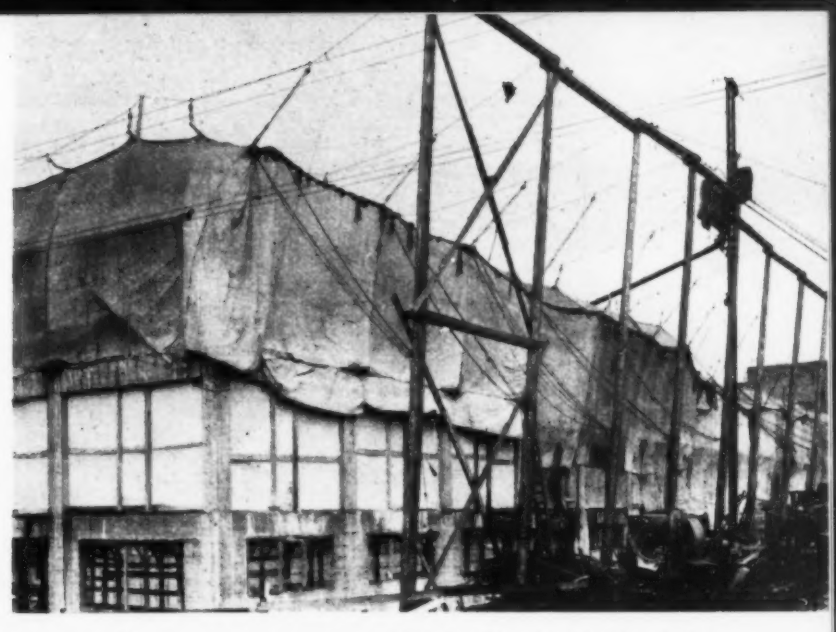
CONNING TOWER CONTROL CAB is mounted on extension atop P&H clamshell crane to give operator clear vision for spotting 4-cu.yd. bucket and swinging 75-ft. boom in coal unloading operations for Galloway Fuel Co., of Milwaukee, Wis. Cab is elevated to height of 30 ft. above ground, commanding view of decks of freighters alongside dock. Floodlights facilitate night unloading operations.

SELF-POWERED SKIP equipped with Ford engine **(above and right)** with sprocket drive to cable drum on front end, delivers concrete from Rex mixer up 26-per cent incline for wasteway at canal undercrossing on U. S. Bureau of Reclamation's Roza Division near Yakima, Wash. Cable on which drum of skip winds is anchored to deadman at top of hill.

DUST MASKS and hard-shell hats **(below)** are items of protective equipment worn by drillers who put down blast holes with wagon drills and jackhammers at Friant dam, U. S. Reclamation Bureau irrigation project near Fresno, Calif.

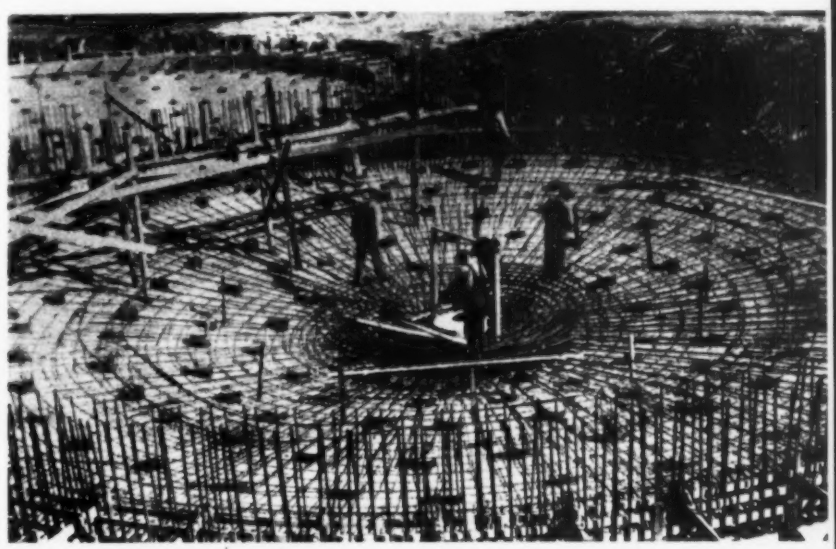
DECK PLATES AND TRACK FASTENERS (below) are welded directly to railroad bridge in Chicago. Using General Electric electrodes, Strobel Construction Co. makes more than 1,000 lin. ft. of butt welds and 1,500 plug welds in anchoring Cor-Ten steel deck plates to bridge girders and track plates to decking.



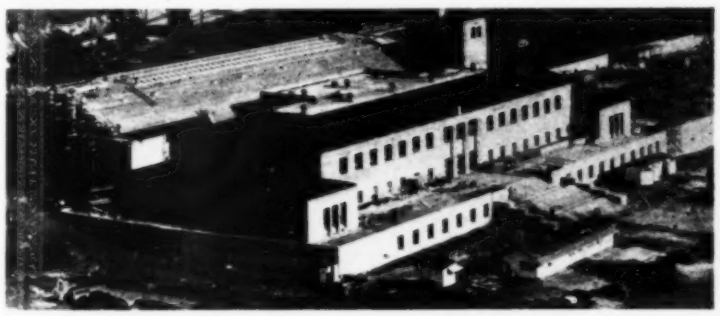


COLD WEATHER PROTECTION (above and right) for concreting building during severe Minnesota winter was provided by Wm. M. Murphy & Son, contractor, of St. Paul, by huge "tent" involving use of 35,000 sq. ft. of canvas. Tent was suspended from wooden poles by wire cables, with fastenings made by Crosby drop-forged steel clips.

TRUCK-DRAWN SHOULDER DRAG proves economical and efficient in maintaining gravel shoulder on roads in District 10 of Texas State Highway Department. Outfit devised by L. A. Wallace, district mechanic, is built from small grader, using auxiliary wheel for support of rear blade.



CONSTRUCTION SPIDER WEB is formed by steel reinforcement in conical bottom of 60-ft.-diameter concrete digester tank for new sewage treatment plant at Rock Island, Ill., built by Stark Construction Co., of Cedar Rapids, Ia. Pile heads under steel bars will be buried in concrete.

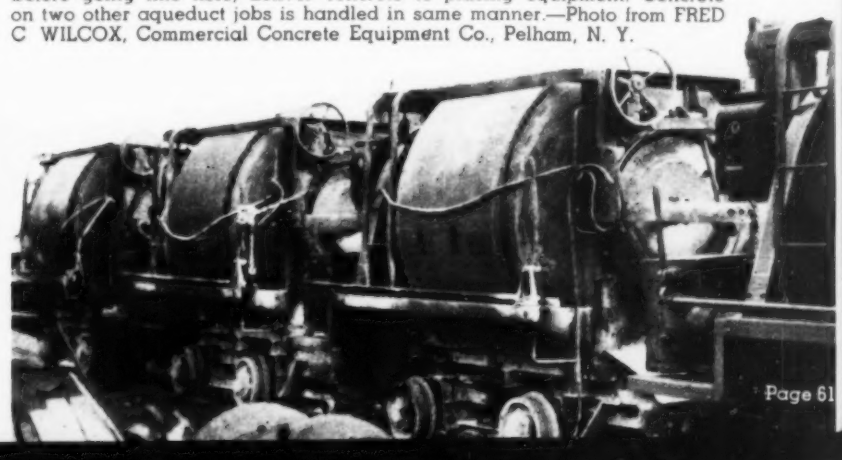


LAMELLA ROOF of trussless wood construction **(above and below)** covering 250x125-ft. drill deck and providing floor area unobstructed by columns for maneuvers of 2,500 men in new armory for Navy and Marine Corps Reserve in Elysian Park near Los Angeles, Calif., is claimed to be largest of its type west of Mississippi River. Huge wood structure for $1,000,000 armory was erected by WPA forces under sponsorship of Los Angeles County.

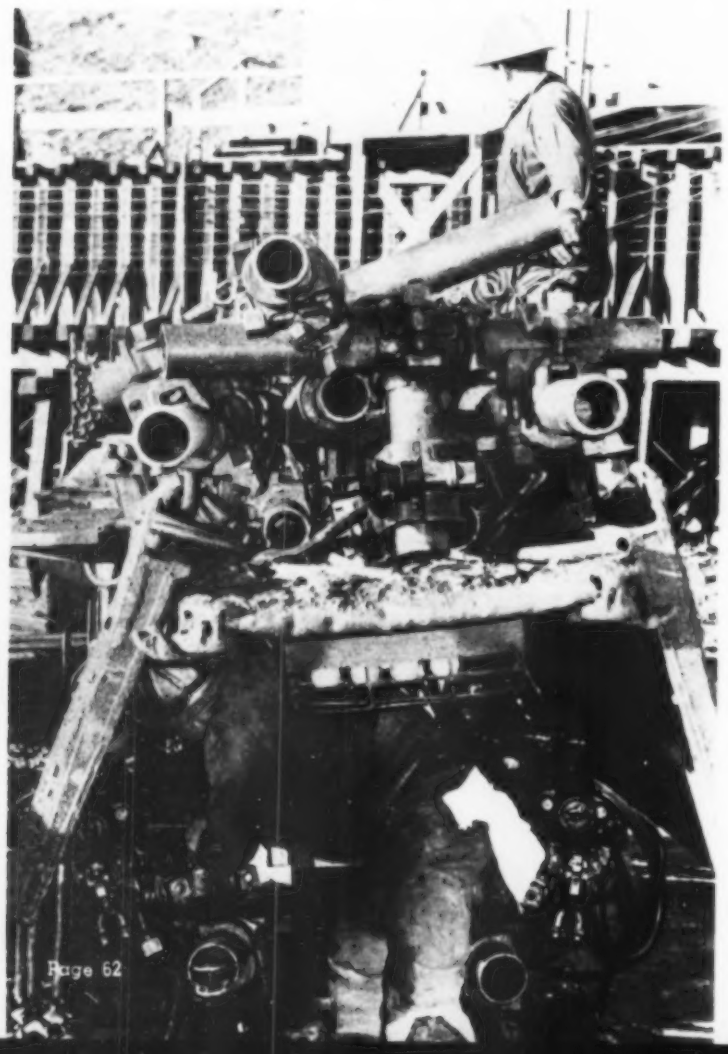
PRACTICAL BENCH CLAMP holds small parts during oxy-acetylene welding. Fabricated of flame-cut welded members, clamp is actuated by long, weighted lever which is integral part of pivoted upper jaw and avoids use of springs or screws. Weight of lever holds jaws of clamp together. Work is released by lifting lever.

The Linde Air Products Photo

FOR LINING DELAWARE AQUEDUCT TUNNEL (below) to 19½-ft. finished diameter on Contract 308 just north of New York City line, J. F. Shea Co., Inc., & Henry J. Kaiser Co. drop concrete through pipe at shaft 22 about 400 ft. to hopper for loading into fleet of Rex 3-yd. Moto-Agitators mounted on industrial cars. Agitator units, several of which are shown on surface before going into hole, deliver concrete to placing equipment. Concrete on two other aqueduct jobs is handled in same manner.—Photo from FRED C WILCOX, Commercial Concrete Equipment Co., Pelham, N. Y.



DRILL JUMBO (above and below) mounts five drills (on two levels) on five bars that swing horizontally around pivot points at rear of carriage, three bars on upper level and two below. As here shown in side and front views, drills have been removed from their mountings and are in place for moving to next position.



Rock Drilling Practice

Maintains Record Speed In Stanislaus Tunnel

By George B. Thacher
Assistant Construction Engineer
Pacific Gas and Electric Co.

ELEVEN MILES of 9½x11¼-ft. unlined, hard-rock tunnel driven with an average daily advance of 38.35 ft. per heading crew is the record set in excavating the Stanislaus tunnel recently completed by construction forces of the Pacific Gas and Electric Co. of California. The tunnel was driven to replace 14.6 mi. of timber flume, which had been in operation since 1908 conveying water from a diversion dam on the Middle Fork of the Stanislaus River to the forebay of the Stanislaus powerhouse, about 130 mi. east of San Francisco. The following analysis of tunneling operations covers rates of driving, allocation of time and, particularly, a summary of drilling methods and practices.

To facilitate construction, the tunnel was divided into three parts: 3.5, 3.7 and 3.8 mi. in length, and the parts were excavated one at a time from three construction adits driven near the center of each part or section. By working in this way only one construction plant was necessary, for upon completion of one section, the entire plant and camp were moved to the next working adit and excavation commenced there.

A short adit, at grade, was driven from near the upper end of each section to the surface and when a section was completed it was placed in immediate operation by diverting the water from the flume into the tunnel through this adit. This saved interest charges and eliminated maintenance on a portion of the ageing flume.

A plan of the tunnel and a combined construction schedule and progress chart for the three sections are shown in an accompanying drawing. The consistently high rate of driving is indicated by the uniform slope of the progress lines on this chart. Lengths of the various sections and data on the tunnel as a whole are shown in one of the tables.

The very simple tunnel section illustrated herewith was adopted. A lower, more nearly circular section would have been more efficient from the viewpoint of theoretical hydraulics, and was, in fact, used for a short time when the tunnel was first started. It soon became evident, however, that the section eventually chosen had distinct advantages in driving economy. The high arched roof provided an ideal location for

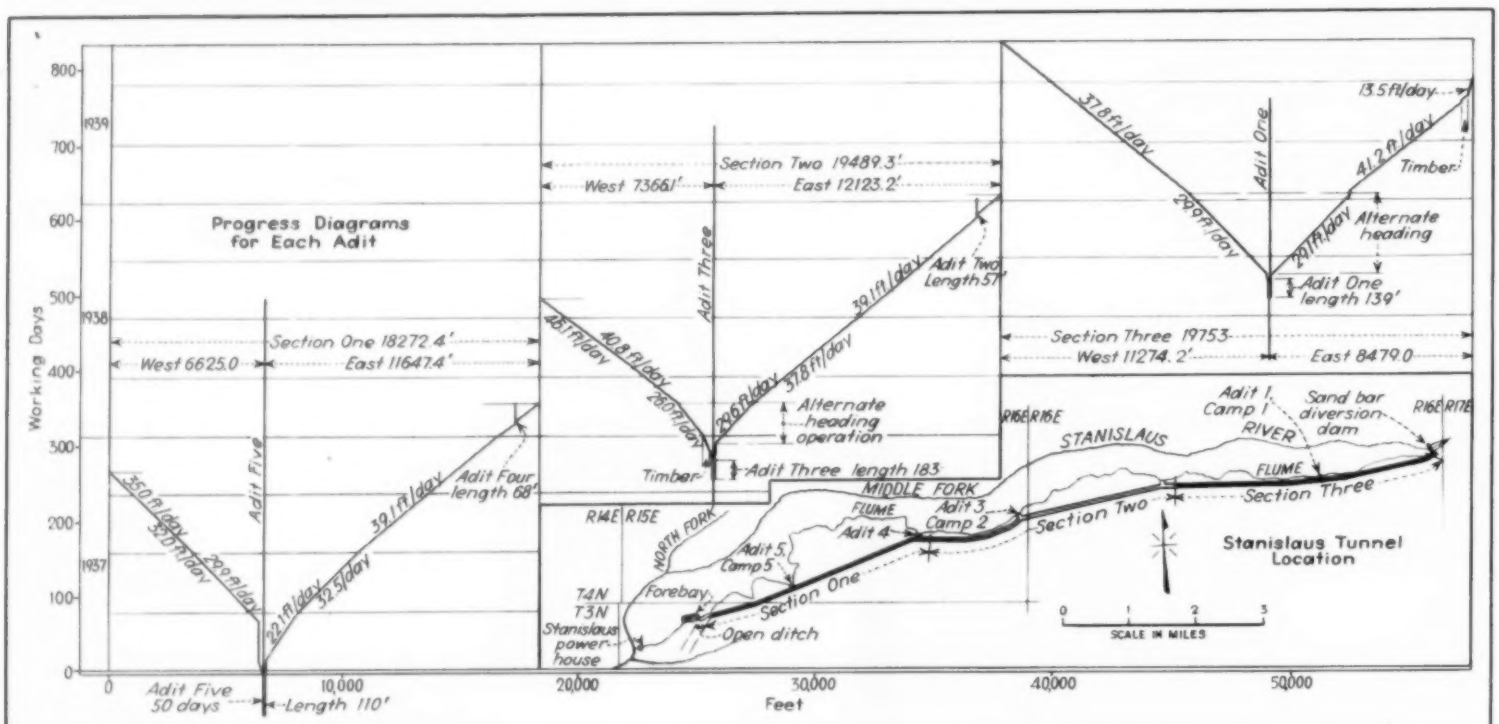
TRAINS OF FIVE OR SIX SIDE-DUMP CARS, each of 5-cu.yd. capacity are hauled by 7-ton storage-battery locomotives. Seven of these locomotives, all General Electric units, were used on job.

CLOSE-UP OF DRILL (below) as set up at face of heading. Drill is mounted on horizontal bar which swings around vertical bar. Note centralizer **(C)** holding drill steel.

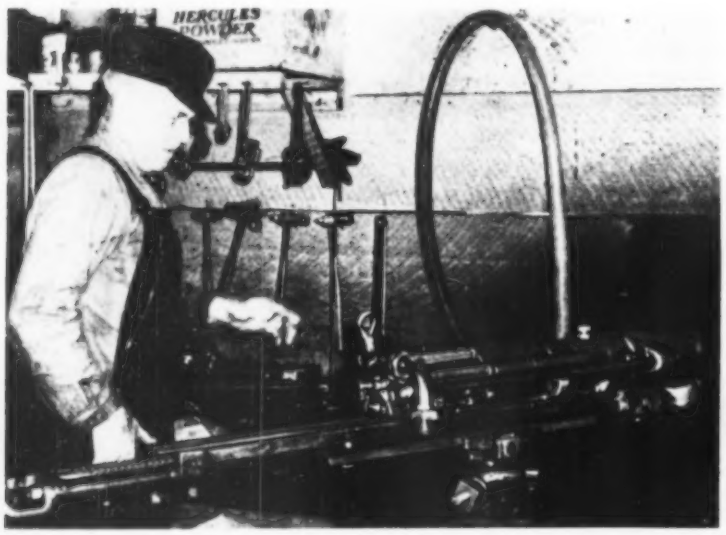
TYPICAL ADIT CAMP at Stanislaus tunnel. Note that steep slopes put a high premium on space for equipment.

the 20-in. ventilating line and the increased headroom made it possible to use larger and more efficient mucking machines. The water-carrying capacity was was not impaired, as was shown by the fact that, although originally designed for a capacity of only 390 sec.-ft., the tunnel has carried 487 sec.-ft. by actual measurement and will probably carry well over 500 sec.-ft.

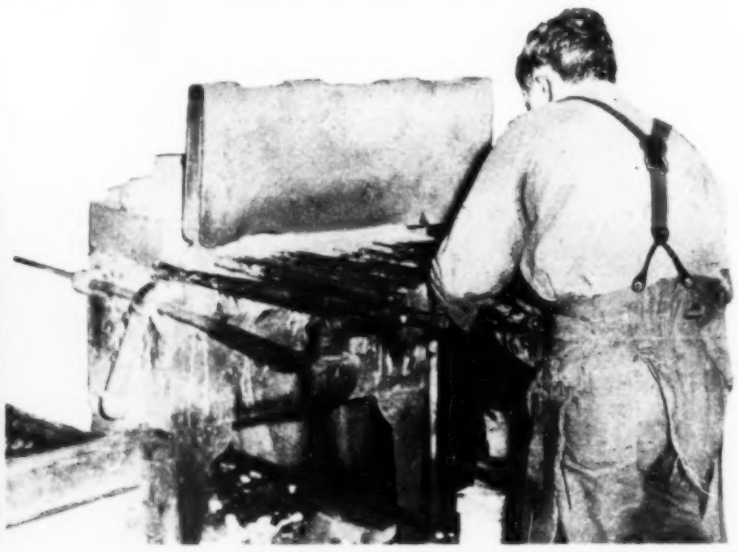
The tunnel was almost entirely in hard rock; only 813 ft. of the 11 mi. required any support. Very little water was encountered and that mostly in pockets which were soon drained. The largest pumped flow (100 g.p.m.) continued for only five days and then decreased rapidly to a steady flow of 15 g.p.m. Granite and grano-diorite formations were penetrated throughout the entire upper two-thirds of the tunnel,



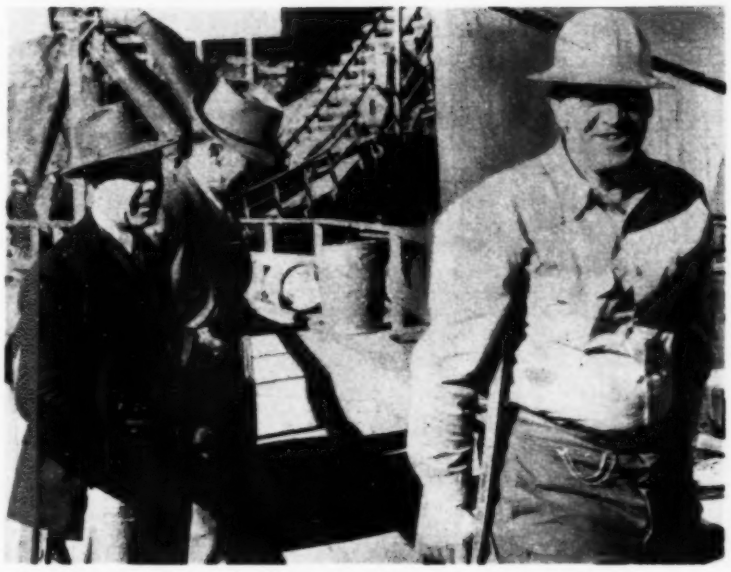
LOCATION PLAN of Stanislaus tunnel and progress diagram showing rate of advance of headings for each adit.



DRILL DOCTOR at work in his shop. Cliff Bamford is an oldtimer at job of keeping drills in first-class operating condition.



OIL BURNING FURNACES are used in heating drills preparatory to carrying on forming and tempering operations.



TUNNEL-DRIVING PERSONNEL includes (at left) J. E. COONEY, construction superintendent, who talks with HECTOR KEESLING, assistant construction engineer, while HARRY SCOTT, tunnel superintendent, moves away chuckling.

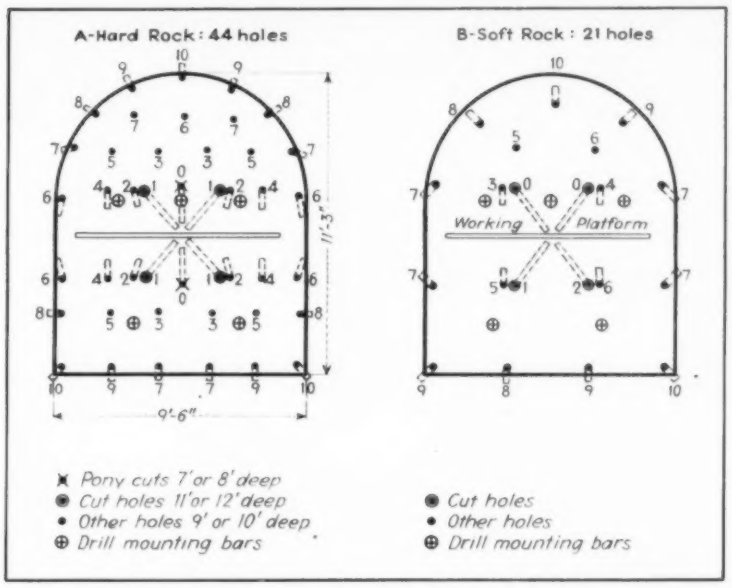
PICKING DOWN LOOSE ROCK after blasting. This picture, taken only 15 min. after the blast, shows that tunnel air has been entirely cleared of blast fumes.

while the lower third consisted mainly of hard, slatey schists. The granite was all hard and blocky, with occasional stretches of extremely hard-drilling, but good-breaking, diorite. The schists varied very widely from fast-drilling, good-breaking, short rock to some of the hardest rock in the entire tunnel.

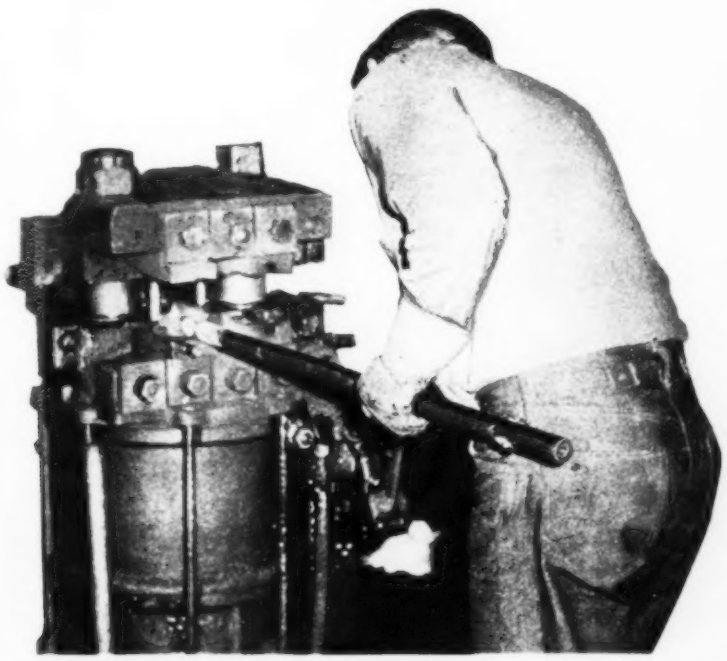
Speed and efficiency in drilling and blasting were major considerations, as these operations consumed almost two-thirds of the total time spent in driving. Two general methods of working the drill crews were used. When excavation was started on Sections 2 and 3, a single crew drilled and blasted alternately, first in one heading and then in the other, while a separate crew alternated with them for the mucking operation. A total of 9,650 ft. of tunnel was excavated in this way. As the headings drew farther and farther apart, the time lost by the crew in moving from one heading to the other finally increased so much that it was more economical to use two separate crews, one in each heading.

This appears in tabulated figures herewith which show the average time per round for the various operations of driving, month by month, by the alternate heading method in Section 3.

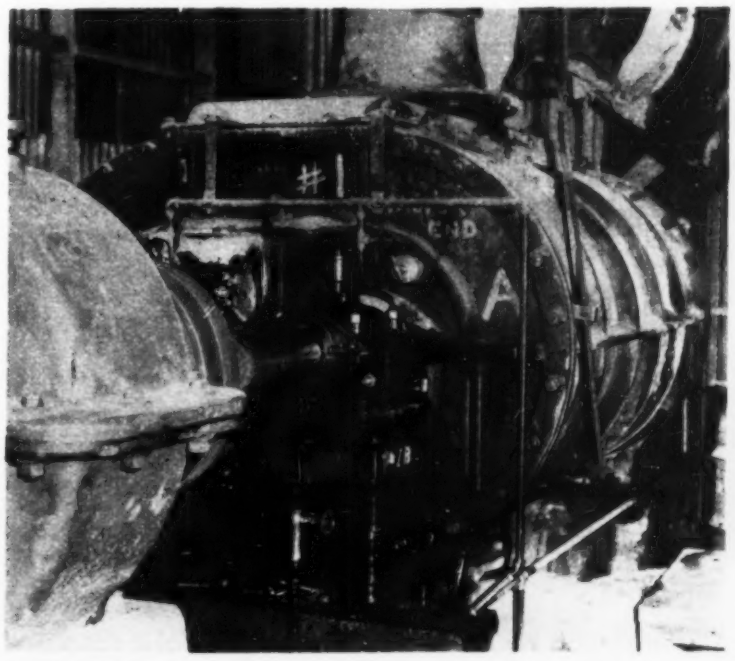
(Continued on page 102)



CROSS-TUNNEL SECTIONS, showing **(A)** 44 drill-hole locations as arranged for very hard rock and **(B)** 21-hole arrangement used in soft rock. Numbers indicate sequence in delay firing.



SHARPENING DRILL STEEL in Gardner-Denver machine prior to loading on racks of jumbo for delivery to heading.



POSITIVE DISPLACEMENT BLOWER, a Root unit, direct-connected to motor through reduction gears, supplies 7,000 cu. ft. of fresh air per minute to each heading.

SMALL TOOLS ON CONSTRUCTION

1

2

3

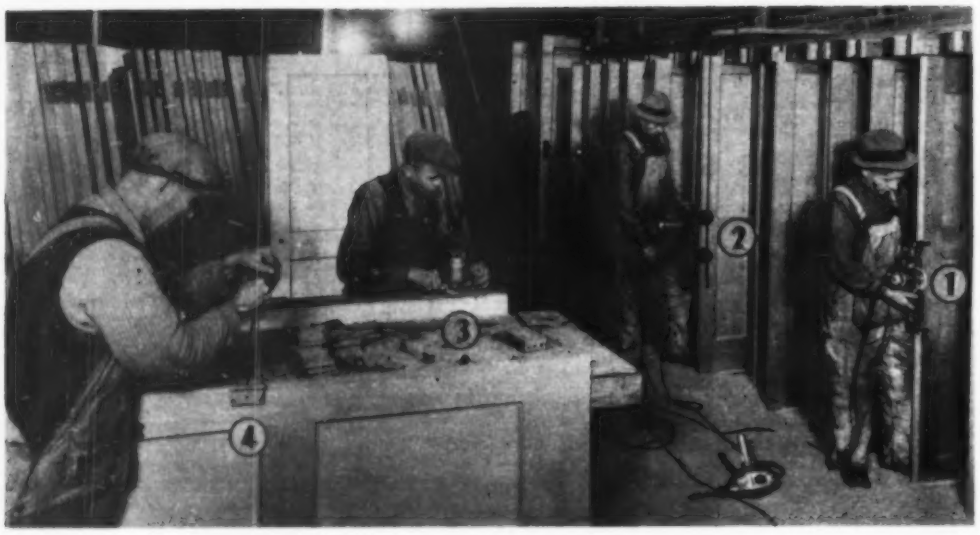
1 CUTTING OF ASBESTOS-CEMENT SHINGLES on job is simplified by use of this device equipped with long handle to produce powerful leverage on cutting blade.

Keasbey & Mattison Photo.

2 HAND HOISTS with worm gears on steel masts up-end precast walls of 5-room concrete building in Sioux City, Ia., constructed by C. F. Lytle Co. Walls are cast flat on ground as illustrated in Photo 3. Triangular steel frame acts as stabilizer to support hoisting mast during early stages of tilting operation.

Photos, Portland Cement Ass'n.

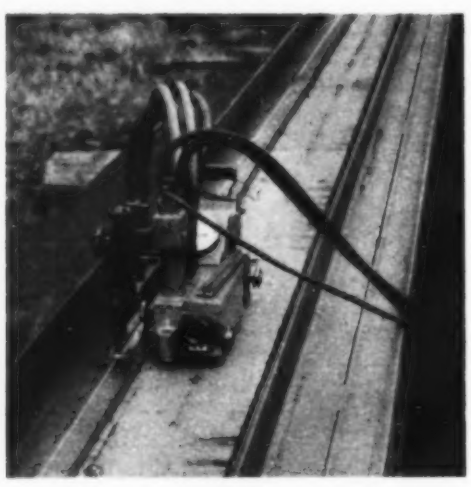
3 PRECAST WALLS for concrete buildings in Sioux City, are built by C. F. Lytle Co. by tilt-up method, using hand hoists on steel masts illustrated in Photo 2. Stabilizer frames are removed and workman is placing 1:3 cement mortar in step joint as tilting operation continues.



4

4 7,000 WOOD DOORS on large building project are prepared for installation by variety of Carter small tools (Stanley) operations (from right to left) require: (1) router to cut lock face parallel with bevel on door; (2) mortiser to cut lock mortises; (3) router with hinge butt templet to form mortises for butts; (4) screwdriver for attaching butts to door.

5



6

5 PIPE RAILS along new Boardwalk at Coney Island, N. Y. are installed with aid of snap-on wrench (Walworth) which handles pipe diameters from 1½ to 2½ in.

Photo, R. A. Wurgel.

6 T-SECTIONS are quickly and economically formed, as needed, by splitting standard steel I-beams with portable oxyacetylene cutting machine. (The Linde Air Products Co.)

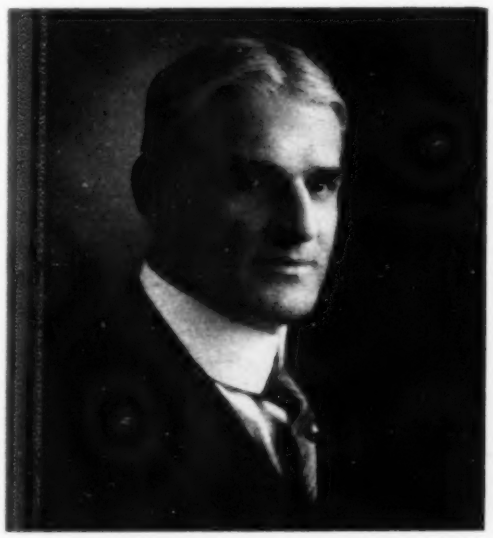
Present and Accounted For

A PAGE OF PERSONALITIES

CHARLES M. CLARK, former deputy chief engineer, Board of Water Supply of New York City, has been appointed chief engineer to fill the vacancy created by the death of Walter E. Spear. Mr. Clark entered the city service in 1893 with the Aqueduct Commission and was in charge of Cross River dam in 1905. Later, with the Board of Water Supply, he served as department engineer of the southern aqueduct department, as division engineer in charge of the 18-mi. Shandaken tunnel, and as department engineer in charge of the 20-mi. city tunnel No. 2. In his present capacity, Mr. Clark will direct work on the 85-mi.-long Delaware River aqueduct to add to New York water supply.

Photo Construction Digest

ILLINOIS CONTRACTORS' ASSOCIATION at its thirty-third annual convention in Springfield, elected the following officers: **(Left to right)** President, J. E. DIPPOLD, of Edwardsville; vice-president, J. F PARKER, of Springfield; director, FRED SHAPPERT of Belvidere.



ROBERT C. WHITING, vice-president, George A. Fuller Co., has been named president of the Building Trades Employers' Association of New York City, to succeed Walter S. Faddis, president, Cauldwell-Wingate Co., who resigned after 18 years of service.

JAMES J. SKELLY, president, James J. Skelly Co., Media, Pa., was recenily re-elected to serve a fourth consecutive term as president of the Associated Pennsylvania Constructors. He is a veteran road builder and last year completed one of the first clover-leaf interchanges in Pennsylvania.

MAXWELL M. UPSON, president, Raymond Concrete Pile Co., New York City, was the recipient last month of an award by the Franklin Institute of Philadelphia for "contributions to the scientific development of foundation engineering and construction, characterized by genius for invention and technical skill".

Nation-Wide News Service

MERWIN A. TYACK (right), since 1932 in charge of the contracts section of the Connecticut State Highway Department, has been promoted to the post of engineer of contracts and construction, filling the position vacated by Arthur W. Bushell, recently named director of engineering and construction.

OLE SINGSTAD (left), chief engineer, New York City Tunnel Authority, was decorated April 8 as Knight, First Class, of the Order of St. Olav, by direction of King Haakon VII of Norway. The decoration, presented by Wilhelm Munthe Morgenstierne, Norwegian Minister to the United States, was "in recognition of Mr. Singstad's engineering accomplishments and his contribution to Norwegian interests in New York."

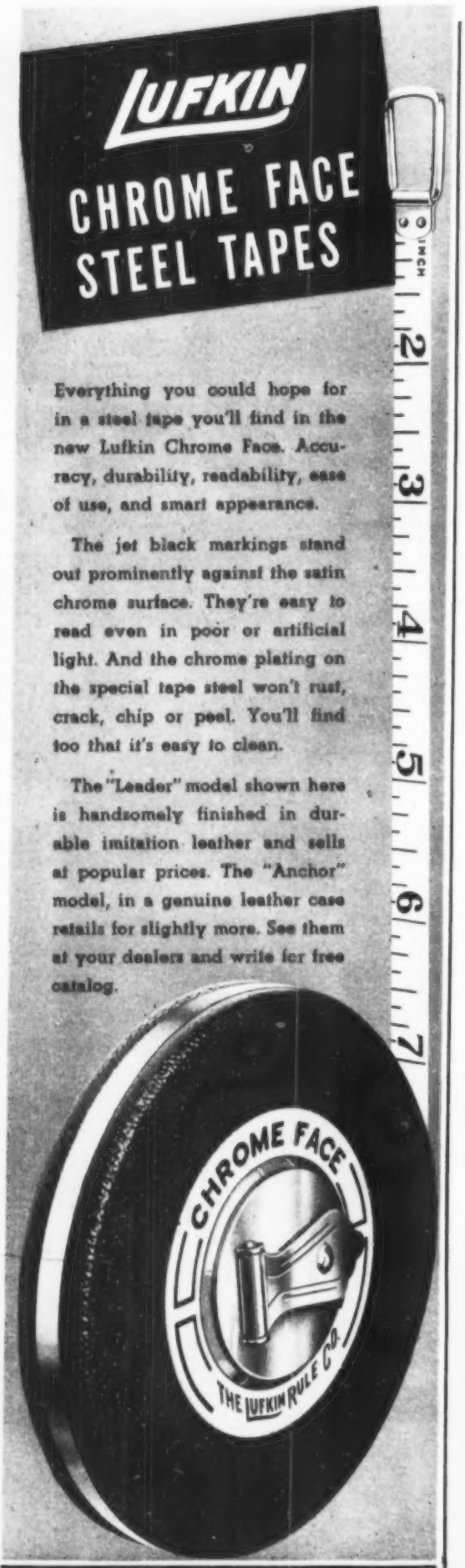
LUFKIN

CHROME FACE STEEL TAPES

Everything you could hope for in a steel tape you'll find in the new Lufkin Chrome Face. Accuracy, durability, readability, ease of use, and smart appearance.

The jet black markings stand out prominently against the satin chrome surface. They're easy to read even in poor or artificial light. And the chrome plating on the special tape steel won't rust, crack, chip or peel. You'll find too that it's easy to clean.

The "Leader" model shown here is handsomely finished in durable imitation leather and sells at popular prices. The "Anchor" model, in a genuine leather case retails for slightly more. See them at your dealers and write for free catalog.



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TAPES · RULES · PRECISION TOOLS

CONSTRUCTION EQUIPMENT NEWS

(ALL RIGHTS RESERVED)

Review of Construction Machinery and Materials for JUNE, 1940

SELF-PROPELLING ¾-YD. CRANE, styled "Supercrane" by its manufacturers, is said to lift and swing load of 6,000 lb. in full circle, 50 ft. from machine without danger of tipping or breakdown. Dual-tire wheel mounting is constructed of 20-in. I-beams running full length of carriage and claimed to support 100 tons dead weight. Requires one engine, one operator and one set of controls. Alloy steel axles 6 in. in diameter. Outriggers, designed as integral parts of understructure, are extended and locked securely to increase stability of machine and fold against sides of understructure for transportation. Other features: ability to handle booms up to 100 ft. or 80- or 90-ft. booms with 20-ft. adjustable jib for goosenecking over walls; worm-type boom hoist independent of swing clutches; loads lowered through gears kept under control at all times by auxiliary precision brake; separate brakes control hoisting and swinging operations which may be carried on at same time. In addition, special travel brake said to be able to bring machine from top speed to dead stop in about 10 ft. — **The General Excavator Co., Marion, Ohio.**

★ ★ ★

TWO-WHEEL HYDRAULIC SCRAPER built for use with 25-35-hp. tractors has struck measure capacity of 2½ cu. yd., heap measure, 3 or 4 cu. yd. With its tractor it may be loaded on truck, thus making it valuable unit for fast moves from job to job. May also be used with rubber-tired tractor, making complete high speed earth-moving and traveling unit that will not damage hard surfaced roads. Operates on low-pressure hydraulic system. Has "double curve" cutting edge said to make loading quick and easy by boiling up earth into apron and bowl of scraper without dead action and preventing it from sticking to sides or bottom—thus speeding up dumping operation. Back dumping feature makes it possible for scraper to dump its load over edge of bank, fill or ramp into trucks or cars. Also to end-dump against foundation walls, bridge abutments or around culverts. When dumping on level, loads may be spilled in heap, adjustable floating tailgate passing over material without dragging it away from dump. If desired, loads may also be dumped in windrows and spread. — **Bucyrus-Erie Co., South Milwaukee, Wis.**

The Job You Want Done Is *Now* Being Done with CUMMINS Dependable DIESELS

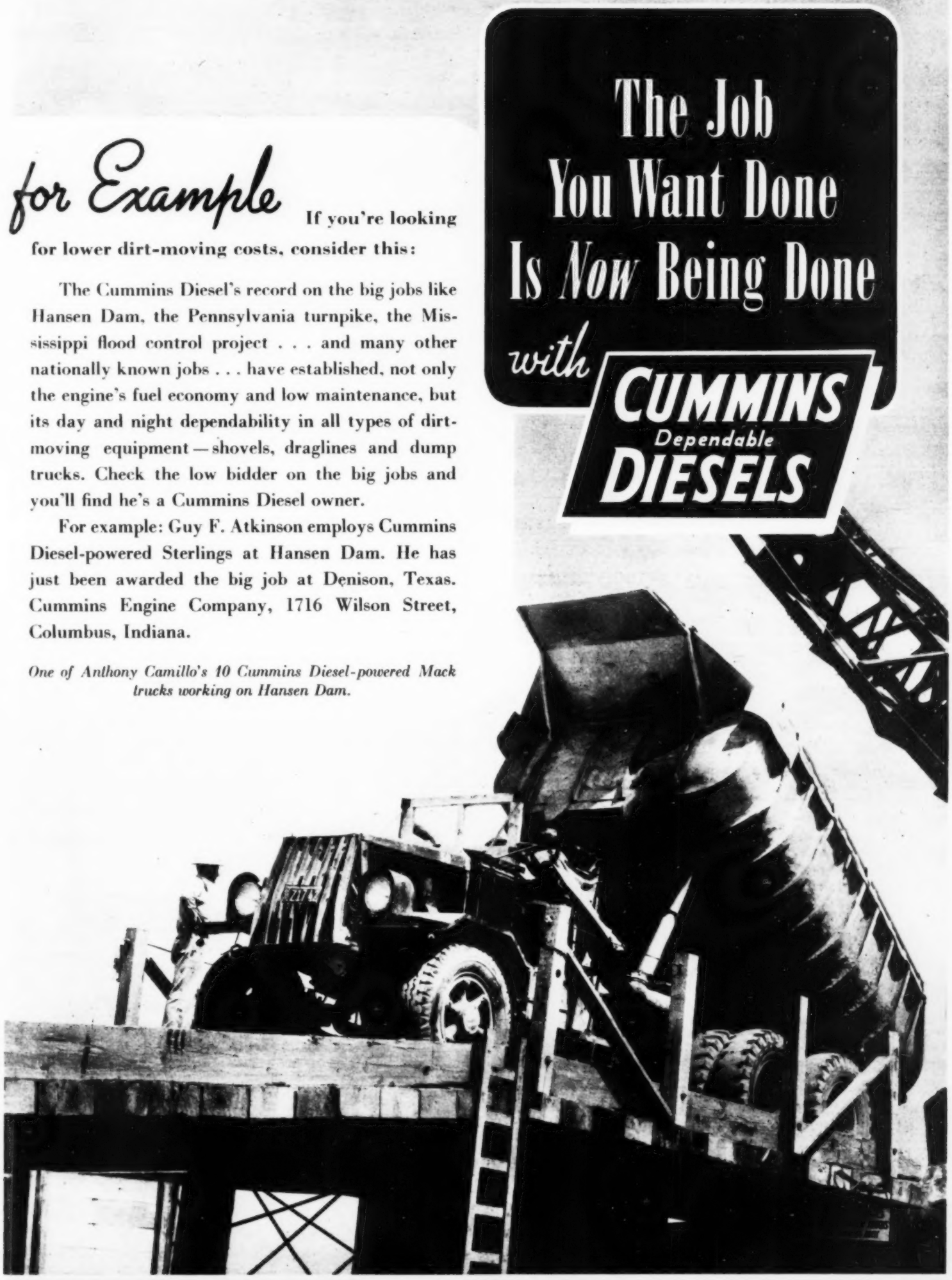
for Example

If you're looking for lower dirt-moving costs, consider this:

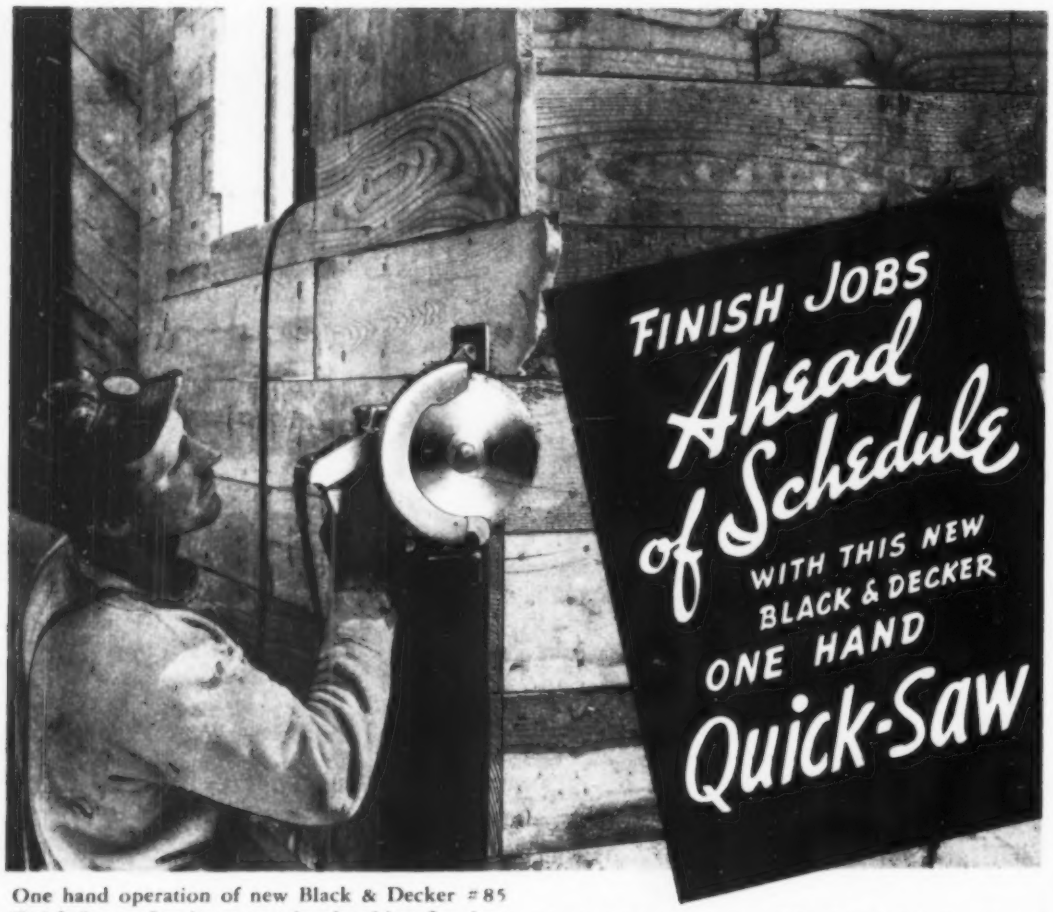
The Cummins Diesel's record on the big jobs like Hansen Dam, the Pennsylvania turnpike, the Mississippi flood control project . . . and many other nationally known jobs . . . have established, not only the engine's fuel economy and low maintenance, but its day and night dependability in all types of dirt-moving equipment—shovels, draglines and dump trucks. Check the low bidder on the big jobs and you'll find he's a Cummins Diesel owner.

For example: Guy F. Atkinson employs Cummins Diesel-powered Sterlings at Hansen Dam. He has just been awarded the big job at Denison, Texas. Cummins Engine Company, 1716 Wilson Street, Columbus, Indiana.

One of Anthony Camillo's 10 Cummins Diesel-powered Mack trucks working on Hansen Dam.



CUMMINS ENGINE COMPANY · COLUMBUS, INDIANA



One hand operation of new Black & Decker #85 Quick-Saw makes it easy to trim sheathing, flooring, roofing.

Black & Decker's new No. 85 Quick-Saw steps up heavy construction jobs *days* ahead of schedule. Easily operated with one hand, it saws concrete forms, scaffolding, falsework, and similar jobs at a fast, cost-trimming pace that backs slow, costly hand-sawing off the map. Cuts to a depth of 2⅝", saws 2x4's on full 45 degree angle. Has simple adjustment for depth and angle of cut. Completely safe—a ball-bearing telescoping guard covers blade at all times. Operates from portable generating equipment, or from any electric socket.

DEEP CUTTING SAW

For extra deep fast cutting on heavy jobs — Black & Decker's new #95 Saw has a verticle depth of cut of 3⅛".

Black & Decker also makes three other saws for every type of job from light to extremely heavy duty sawing. Ask your jobber to demonstrate how dependable B & D Saws speed up work and save costs, or write to: The Black & Decker Mfg. Co., 759 Penna. Ave., Towson, Md.

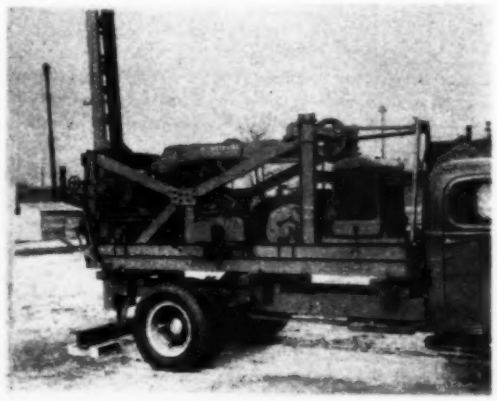
BLACK & DECKER #75 SAW being used with abrasive disc to slot stone. Other accessories include blades for metal cutting, nail cutting, compo-board.

FREE SAW HANDBOOK just off the press shows many ways to use portable electric saws to cut costs, speed up work. Profusely illustrated—it's FREE. Write today.

Smallest of the line is the Black & Decker #35 Saw. Ideal for light cut off and trim work.

LEADING DISTRIBUTORS EVERYWHERE SELL
Black & Decker
PORTABLE ELECTRIC TOOLS

PORTABLE, ALL-STEEL DRILLING MACHINE, designed for mounting on trucks with standard chassis, has electrically welded main frame 13 ft. long with main sills 12 in. deep. Outstanding feature is ease and speed with which machine can be put on location and in action. Mast is raised by power, upper section latching automatically. Guy lines already



are connected to top and lower sections and with stakes and stake eyes regularly supplied, anchoring mast and rigging are said to be matter of few minutes. Mast telescope can be used either at 40- or 50-ft. heights and is built for safe working load of 15,000 lb. Another feature: air cooling of bull wheel and sand reel brakes. Weight of brake lever alone said to be enough to keep reel from slipping when spudding. Double crank spudder has built-in shock absorber with recoil control and is adjustable to various weights of tools. All controls within easy reach of operator. Three reels (bull, sand and call) are said to be of extra large spooling capacity, to be fast, free running and equipped with movable dividers. Two speeds on bull reel provide for swabbing and other heavy jobs. Powered by Hercules 6-cylinder, gasoline engine 3¼x4½-in. bore and stroke.—**The Star Drilling Machine Co., Akron, Ohio.**

★ ★ ★

COATING FOR CONCRETE called Dye-Crete claimed to form hard, permanent surface resistant to wear and tear of traffic and to attacks by alcohol, grease, oil, water and dilute chemicals. Said to be more than mere surface coating, penetrating old or new concrete or masonry, coloring particles in rich shades; to assure clean, attractive and dust-proof floors and easy sweeping and mopping; to dry quickly, to need no buffing, and to maintain uniform color as surface wears. Applied in two coats: (1) Dye-Crete stain mopped on to surface, (2) varnish coating, same color as stain which provides hard finish and adds luster. Varnish coating may be obtained in four colors, club green, tile red, battleship grey and chestnut brown, and may be used by itself as finish for linoleum or wood floors — **Wilbur & Williams Co., Park Square Bldg., Boston, Mass.**

★ ★ ★

PNEUMATIC CHAIN SAW, 24-in. capacity, is recommended by its makers for cutting off piles under or above water; also for tree felling and cutting

large size timber or lumber. Especially useful to contractors, railroad constructors, bridge builders, public utilities, forestry departments and road builders. Powered by 3.5-hp. motor at 90-lb. pressure, free speed of chain, 1,000 f.p.m.; net weight, 50 lb — **Mall Tool Co., 7740 S. Chicago Ave., Chicago, Ill.**

HAZARD LAY-SET
Preformed...
At Ease on every job

● Regardless of the machine or job—shovel, crane, hoist, scraper, elevator, whatnot—Hazard LAY-SET Preformed will give you the same amazing resistance to fatigue, the same uniformly long life—because Hazard LAY-SET is *"at ease."* The preforming process at the mill relieves the rope of locked up stresses; leaves it flexible, easy to handle, willing to work. Hazard LAY-SET Preformed is so calm, so thoroughly "at ease," that it has almost no tendency to kink, it resists whipping or rotating in sheave grooves, it spools better. More than this Hazard LAY-SET Preformed is a safer rope to handle. Being "at ease" broken crown wires do not spring out to tear workmen's hands and possibly cause blood-poisoning. For your next rope specify Hazard LAY-SET Preformed and be "at ease" yourself about its greater dollar value.

HAZARD WIRE ROPE DIVISION • WILKES-BARRE, PENNSYLVANIA

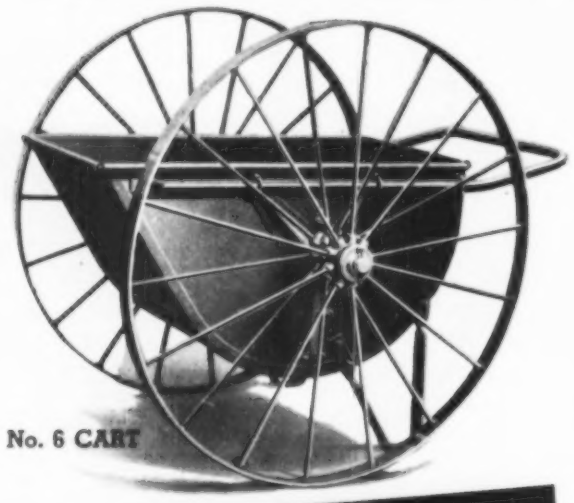
Established 1846

District Offices: New York, Chicago, Philadelphia, Pittsburgh, Fort Wayne, San Francisco, Denver, Los Angeles, Atlanta, Tacoma

GREEN SIGNIFIES SAFETY

AMERICAN CHAIN & CABLE COMPANY, Inc.

THE CART THAT CAN TAKE IT



No. 6 CART

FOR HEAVY DUTY

12 gauge tray all welded.

½" dia. continuous butt-welded rod at top of tray.

Malleable brackets extending full depth of tray.

42" diameter wheels—flat or oval tire.

Plain or roller bearings.

Can be equipped with 44" diameter pneumatic tire wheels.

Other carts having 30" or 36" diameter steel wheels, and 30" diameter pneumatic tire wheels.

STERLING
WHEELBARROW CO.
7100 W. WALKER ST.
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SMITH TILTERS

for POURING BIG VOLUMES OF CONCRETE

FASTER DISCHARGE
You merely tilt the drum and let gravity pour out the entire batch . . . the quickest and most practical method of discharge—like emptying a pail.

Recent improvements in design and construction place the Smith Tilter further ahead than ever. Three of these improved 2-yard mixers were just recently shipped to the T. V. A. for the Watts Bar Dam in Tennessee. Another one just sent to the U. S. Reclamation Department for the Parker Dam. All sizes up to 4-yard. Write for catalog.

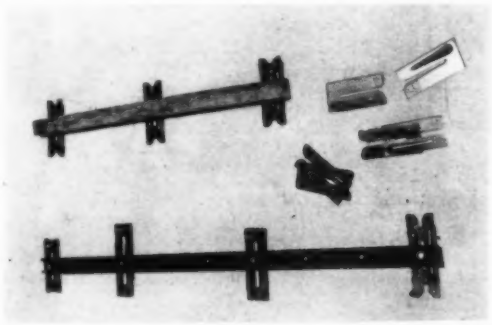
SMITH TILT AND POUR!

All-time Concrete Pouring Records were established by Smith Mixers at Boulder Dam, Marshall-Ford Dam, Norris Dam, Radford Dam, Tygart Valley Reservoir and other World Famous Projects.

THE T. L. SMITH COMPANY
2851 N. 32nd Street • Milwaukee, Wis., U. S. A.

USED ON THE WORLD'S GREATEST CONCRETE PROJECTS

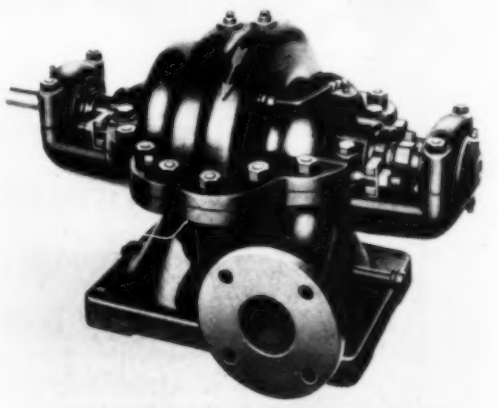
METAL SHIM, designed to provide accurate, permanent and inexpensive shimming for all types of leveling and alignment work, was invented by L. F. Urbain, architect. Said to fill need for efficient device for beveling floor sleepers, for shimming furring, and door and window jambs. Consists of metal plates used in pairs having interlocking legs, one of which has been stamped with graduated raised



portion which forms wedge. Plates crimped to give positive interlock and to assure permanent position when driven into place. Shims, knocked toward each other to obtain necessary level or alignment, are provided with slots to straddle nail in fastening material to be shimmed, thus eliminating any longitudinal movement and providing equal shimming on each side of point of bearing as well as on each side of material. Holes provided to fasten shims in position to eliminate lateral movement. Made in three weights: lightweight for ordinary work; medium for heavier construction including shimming of joists and girders, and heavy weight for use in metal and masonry construction. Available in terne plate and galv.-annealed in all three weights—**Loxit Co., 605 W. Washington Blvd., Chicago, Ill.**

★ ★ ★

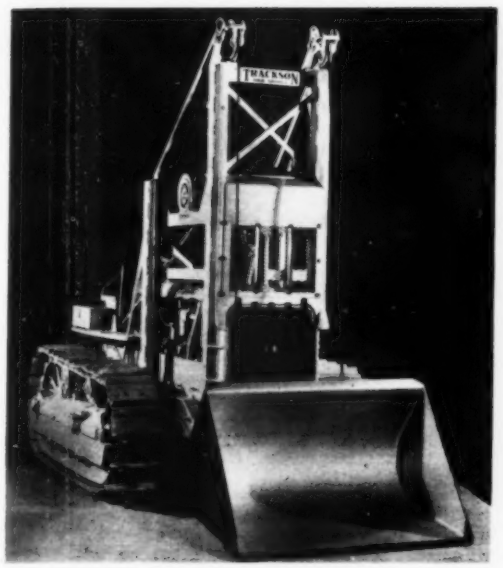
TWO-STAGE, SPLIT-CASE PUMPS, with capacities up to 500 g.p.m. at total dynamic heads ranging up to 600 ft., are said to be suited to all classes of general pumping service where liquid is of low viscosity and free from foreign matter. Used for water supply to high buildings, by small municipalities, industrial and process plants, for boiler feed and hydraulic elevators. Features: (1) One-piece impellers of cast iron hard bronze or other



alloy depending upon requirements; (2) "back to back" mounting shaft to assure proper hydraulic balance; (3) removable wearing rings with streamlined water guiding surfaces on both casing and impellers; (4) high manganese alloy steel shaft journaled in ball bearings of ample size to withstand all thrust and radial loads; (5) centrifugally-cast bronze shaft sleeves mounted on shaft to protect it against abrasive or corrosive action of liquid; horizontally divided bronze glands to facilitate removal and adjustment of packing; (6) compact casing horizontally divided so that upper casing may be lifted to expose entire rotating element.—**Fairbanks, Morse & Co., 600 S. Michigan Ave., Chicago.**

★ ★ ★

LIGHTWEIGHT DIGGING AND LOADING MACHINE called "Traxcavator" is combination of Trackson shovel and R2 gasoline or D2 diesel-powered Caterpillar tractor. Designed to meet demand for smaller, more compact shovel capable of handling such jobs as shoulder trimming and ditch cleaning, general excavation; of loading sand, gravel or other

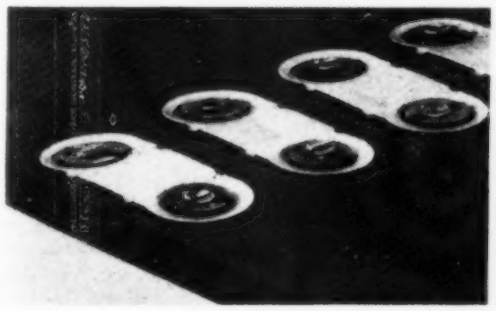


road materials. Can be placed readily on trucks and trailers for quick transportation on streets and highways. Choice of five forward speeds provides flexible range for various jobs and machine travels around on its own power at 5 m.p.h. Makers claim it will handle job from start to finish—digging, loading, leveling, backfilling, bulldozing and drawbar work at low cost. Lifting height, 8 ft. 5 in. from ground to bottom of bucket; dumping clearance, 7 ft. from ground to lowest point of bucket in dumped position. Bucket, ½-yd. capacity. Overall height 10 ft. 1 in.; length, 13 ft. 7 in.; width, 5 ft. 2 in. Extra equipment, bucket 63 in. wide; hardened steel bucket teeth; structural steel 66 in. wide x 30 in. high bulldozer blade with reversible cutting edge.—**Trackson Co., Milwaukee, Wis.**

★ ★ ★

BELT FASTENERS in new size for joining elevator and conveyor belts from 5/16 to ½ in. thick consist of metal plates which span joint on opposite sides of belt and are drawn tightly together by two large

size bolts through belting. Bolt heads and nuts are countersunk and protruding bolts are broken off. Fasteners said to be flat and smooth on both sides and to travel around pulleys as small as 14 in. in diameter. Makes tight butt joint. Templet locates



bolt holes slightly wider than bolt centers of fastener. When bolts are inserted and drawn into position, belt ends are forced together tightly, forming seal through which material cannot sift. Fasteners may now be obtained in six sizes which may be used to join belts from ¼ to 1½ in. thick and of any width.—**Flexible Steel Lacing Co., 4607 Lexington St., Chicago, Ill.**

★ ★ ★

AIR HOSE FOR PNEUMATIC TOOL SERVICE has tube of non-porous rubber said to be resistant to action of hot and cold air and to be unaffected by lubricants, obviating clogging of tools with rubber particles. Reinforcement provided with three plies

Cofferdams

COST LESS BUILT WITH CORRUGATED

Steel Sheet Piling

And here's a typical job that illustrates the point. It's a cofferdam constructed to permit the installation of a new intercepting sewer line.

Because Corrugated Piling is strong and light, it can be handled and driven with greater speed at less expense. Watertight design reduces seepage to a minimum and cuts pumping costs. And, when the work is completed, the piling can be reclaimed for further use.

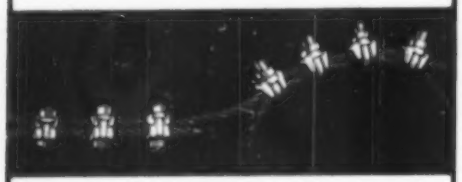
Strength, light weight, easy handling, watertight design and high salvage value—these are the features of Corrugated Piling that enable this product to save you money and serve you better when used for cofferdams, sewers, dams, levees, bulkheads, sewage disposal plants and bridges.

Write for catalog describing Corrugated Steel Sheet Piling and its many uses. Address request to Dept. CM-6.

THE UNION METAL MANUFACTURING CO. CANTON OHIO

THERE'S NO CRIMPING WITH THIS CLIP — IT GRIPS LIKE A FIST!

The Laughlin drop forged Safety Clip grabs wire rope with a grip like a fist—a vise-like, solid clench that *stays put*. When removed, it leaves the wire rope straight, uncrimped, ready to use again.



FOOLPROOF. Laughlin Safety Clips are easier and safer to apply. They can't be put on wrong. No fussing or waste of time. And three Laughlin Safety Clips will do the job of four ordinary U-Bolt Clips.

DOUBLED EFFICIENCY. Tests recently made by a leading engineering school prove Laughlin Safety Clips 50% more efficient than ordinary U-Bolt Clips.

FREE BULLETIN TELLS MONEY-SAVING FEATURES OF LAUGHLIN SAFETY CLIPS

These tests are described in a new booklet — which also gives other advantages to be gained by using Laughlin Safety Clips. Fill out the coupon below — and mail today. No obligation.

THE THOMAS LAUGHLIN CO.
Portland, Maine

Please send me free Safety Clip booklet. B-5
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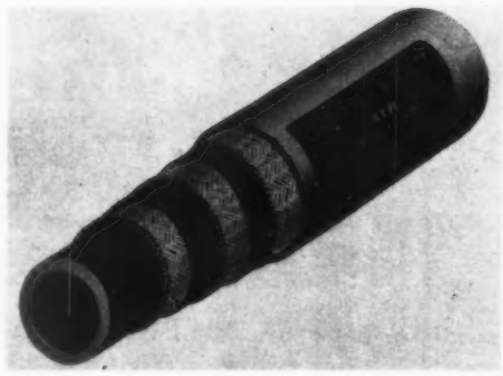
Look for Laughlin products in Thomas' Register and buy through your distributor.



of multiple-braided, special cabled cotton yarn, claimed to provide safety factor for working pressures and resistance to blows and impacts. Heavy-gage soft red rubber cover with high tensile strength said to provide adequate resistance to cutting from rocks, ore and materials and to be abrasion- and sun-resistant. Available in ½-, ¾- and 1-in. sizes. —**Mechanical Goods Division, Goodyear Tire & Rubber Co., Akron, Ohio.**

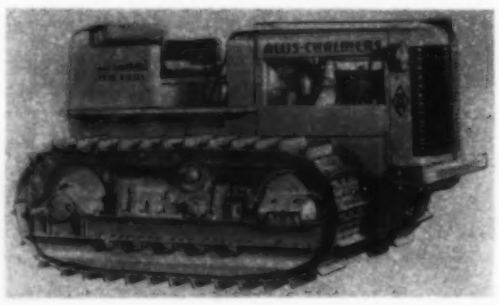
★ ★ ★

FOUR NEW HEAVY-DUTY TRUCKS with rated capacities ranging from 3½ to 7½ tons have been added to Federal line to fill need of truck operators who do not wish to overload or overwork engines and chassis too light for their requirements. Model 35, rated

at 3½-5 tons is powered by Waukesha 6-cylinder, 7 bearing engine with 381-cu. in. displacement, 4¼x4¾-in. bore and stroke and with ability to develop 105 hp. at 2,600 r.p.m. Completing unit power plant is W. C. Lipe 13-in. single dry plate clutch and Clark 5-speed transmission. Frame is 10-in. deep. Timken axles with bevel drive rear. Hydraulic brakes amplified by vacuum booster. Other models: No. 45 rated 4-6 tons; No. 555—6 tons; No. 55 H, rated 5—7½ tons.—**Federal Motor Truck Co., Detroit, Mich.**

★ ★ ★

DIESEL CRAWLER TRACTOR claimed to cut to minimum operating costs in handling two- and four-wheel scrapers up to 10-yd. capacity, 12-ft. blade graders, bulldozers, trailbuilders, winches, logging arches and like equipment, is powered by General Motors 2-cycle 4-cylinder diesel engine which provides 95 belt horsepower and 79 drawbar horsepower with drawbar pulls up to 18,430 lb. Tractor



has "Velv-touch" bi-metallic steering clutches and brakes and "Positive-seal" truck wheels and is built complete with extra-heavy crankcase, radiator, and truck-wheel guards, muffler, hour meter, adjustable radiator shutters, bumper, front pull hook and electric starting and lighting. Available in two-tread widths, 62 and 74 in., narrower model weighing 19,900 lb. and wider one 20,700 lb. Constant mesh gears permit shifting while traveling with six speeds forward and two reverse. Because engine can be throttled down almost to half engine speed without losing drawbar pull, speed range is provided from 1.58 to 6.03 m.p.h.—**Tractor Division, Allis-Chalmers Mfg. Co., Milwaukee, Wis.**

CUMMER
ASPHALT PLANTS

- Portable Combination Hot and Cold Mix Plants
- Portable Hot Mix Plants
- Stationary Combination Hot and Cold Mix Plants
- Cummer Combination Dryer-Coolers.
- Steam Jacketed Mixers 400 to 8000 pounds capacity.
- Cummer Internal Fire Dryers
- Electric Batch Timers
- Cummer Automatic Asphalt Meters

THE F. D. CUMMER & SON CO.
Euclid and 17th Cleveland, Ohio

"U.S." ELECTRIC PLANTS
For Construction Work

1250 WATT PORTABLE

A made-to-order plant for construction work. Two sizes: 1250 watts and 2500 watts. For operating tools or flood lighting. Lightweight, compact, and equipped with carriers for easy portability. Air-cooled, 4 cycle, quick starting. 2 gal. fuel tank. Ruggedly built for hard usage.

WORLD'S MOST COMPLETE LINE

We are builders of the world's most complete line of Electric Plants. In all parts of the world, U.S. plants have proved their steadfast dependability. And the reason: "U.S." generating sets are designed to meet the conditions under which they will operate.

LARGER SIZES

Larger sizes are available. Illustration to the right is 5KW, 4 cylinder portable unit mounted on trailer with weather-proof hood. U. S. line includes models up to 75 KW, AC, DC, all types of controls and voltages. Write for complete information.

DIESELS

For continuous, heavy-duty service at low cost. U.S. Diesel Electric Plants offer a complete range of sizes from 3 KW to 75 KW—1, 2, 4 and 6 cylinder models.

UNITED STATES MOTORS CORP.
431 Nebraska St., Oshkosh, Wis.

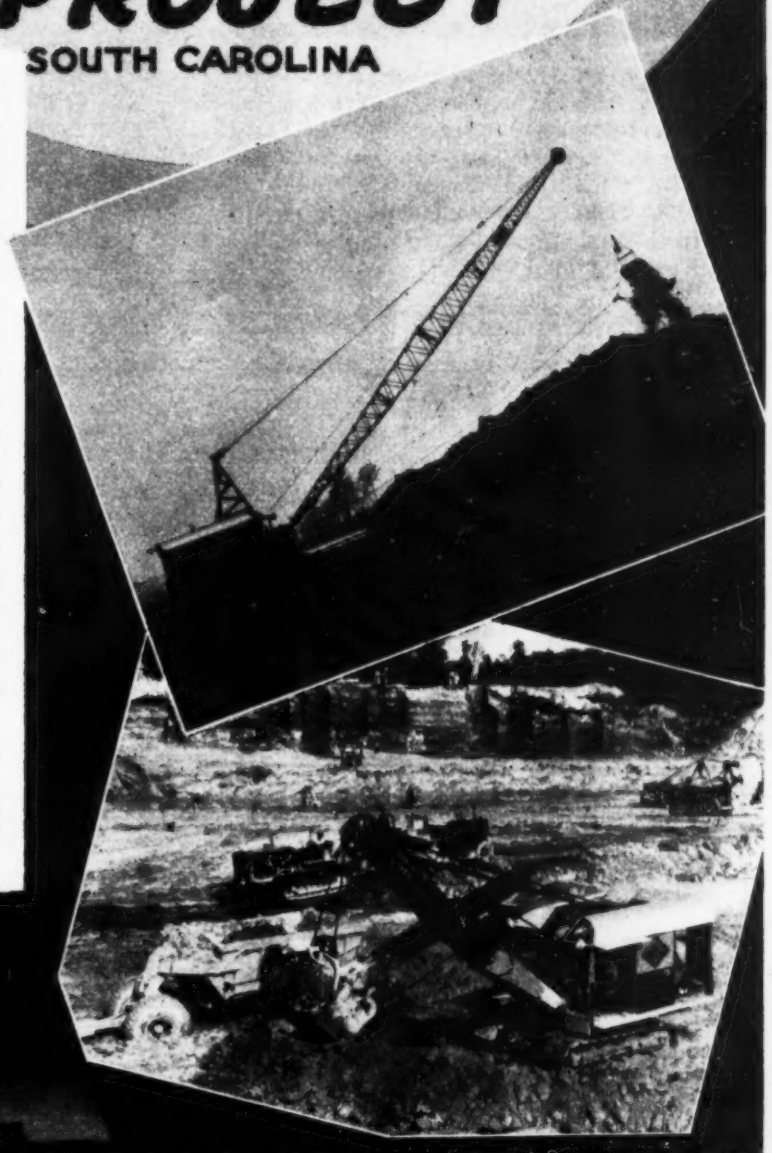
LIMA

Shovels and Draglines Hold the Spotlight on the $40,795,000 SANTEE-COOPER POWER and NAVIGATION PROJECT

SOUTH CAROLINA

10

THE fact that seven of the country's leading contractors chose 10 LIMA shovels and draglines to do the major part of the excavating on the Santee-Cooper Power and Navigation Project in South Carolina, proves again that when big jobs are to be done quickly and economically, LIMA gets the call. Contractors who are doing the big jobs from coast to coast, like the LIMA design because of its many profitable advantages. For instance, LIMA'S ability to handle long booms at low angles, made it possible for two LIMA draglines to strip the 300′ wide base for the dam in two operations; one dragline dug and cast the material to be re-handled by the second dragline. You, too, can cut your excavating costs with LIMA shovels, draglines and cranes.



Top—LIMA dragline owned by Boone and Wester, Inc., Memphis, Tenn. *Bottom*—LIMA shovel owned by Sammons-Robertson Co., Huntington, W. Va.

LIMA LOCOMOTIVE WORKS, Incorporated
Shovel and Crane Division - - - - - - LIMA, OHIO

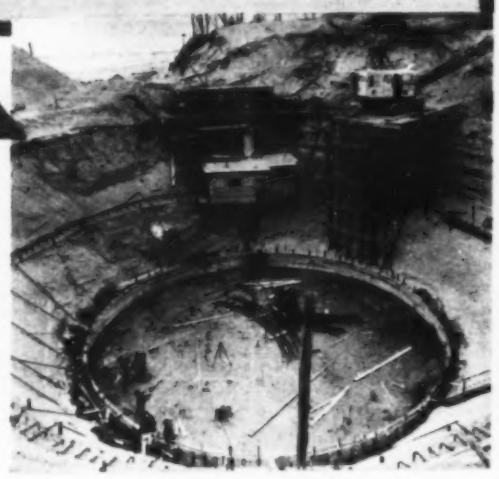
NEWARK, N. J. NEW YORK, N. Y. DALLAS, TEXAS CHICAGO, ILL. MEMPHIS, TENN.
LOS ANGELES, CALIF SAN FRANCISCO, CALIF. SEATTLE, WASH PHILADELPHIA, PA.
SPOKANE, WASH. PORTLAND, ORE. MONTREAL, Quebec, Can. VANCOUVER, B. C.

LIMA

LIMAS ARE BUILT IN ¾ YARD CAPACITY AND LARGER

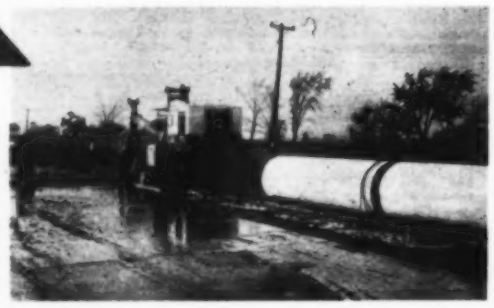
3 VERY SPECTACULAR AND DIFFICULT JOBS COMPLETED IN RECORD TIME WITH GRIFFIN WELLPOINT SYSTEMS

1 FOUNDATION PRE-DRAINAGE



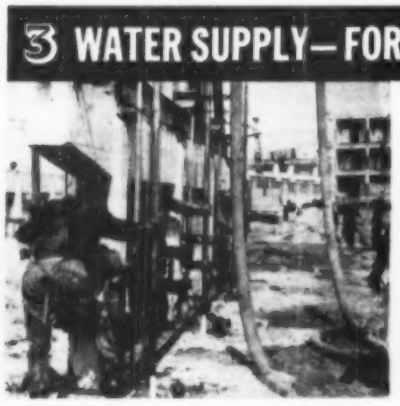
The Intake Well for the Lake Michigan to Grand Rapids Water Supply System. Owen-Ames-Kimball Co., Grand Rapids, Contractors. The construction of this wet well is considered the most spectacular and difficult part of the entire $4,000,000 water project; 70 ft. in diameter — bottom 35 ft. below Lake Michigan. To avoid an immense amount of sheet piling and bracing an open cut was made — ALL BANKS SLOPED — AFTER the hole had been pre-drained with a TWO-STAGE Griffin Wellpoint System.

2 TRENCH PRE-DRAINAGE



Over A MILE A WEEK of 46" concrete pipe for over 31 miles was laid between Lake Michigan and Grand Rapids by Price Bros. Co., contractors, and Chas. F. Smith & Sons, Inc. (Sub-Cont. Sec. C). 5 Griffin Wellpoint Pumps, 2400 feet of 6" Header, 300 Wellpoints and 2 Griffin Jetting Pumps were used to pre-drain from 2 to 7 feet of ground water in record time.

3 WATER SUPPLY—FOR JETTING



(Large Volume with High Pressure)
At the Coney Island Boardwalk Relocation—The Arthur A. Johnson Corp. and Necaro Co., Inc., used a novel jetting device to shift 16 ton concrete pile bents intact from the old location to the new location as much as 350 feet inshore. The Pumping Station with 8 pumps, wellpoint supply system along beach and jetty and 2800 ft. distribution main was furnished and installed by the Griffin Wellpoint Corp. on a flat guarantee to deliver all water and pressure needed to do the work.

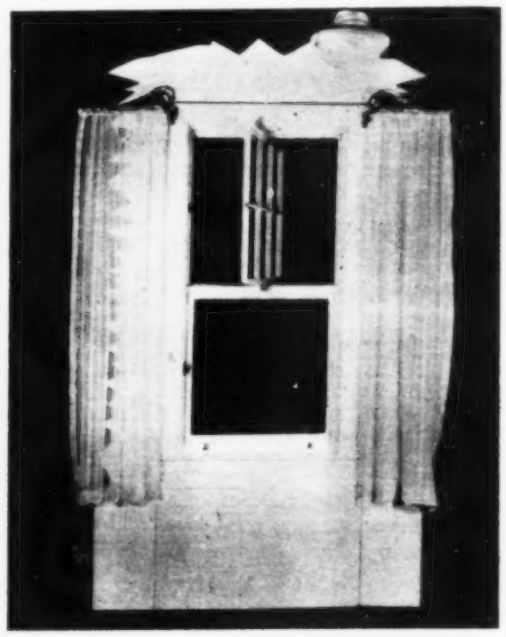
"There's a Difference Worth Having"

Wellpoint Systems and Jetting Equipment for any size job . . . anywhere

RENTALS . . . SALES

GRIFFIN WELLPOINT CORP. 725 East 140th Street NEW YORK, N. Y.

DOUBLE-HUNG WINDOW has lights mounted in frame separate from upper and lower sash frames. This inset frame is pivoted at center, top and bottom. Joints are so shaped that interior frame turns vertically on central pivot. By turning both upper and lower sashes 90 deg., practically 100 per cent



UPPER PART of sash opened 90 deg.

ventilation may be obtained. Pivoted units also may be turned complete 180 deg., thus bringing outside face to inside of room for cleaning, painting, repairing and glazing, thus doing away with such outside activities and obviating need for safety belts, hooks and costly risk insurance. Concealed behind trim at top and bottom are roller screens (optional equipment) attached to top rail of upper

BOTH SASHES partly open. Both screens visible.

sash and bottom rail of lower sash. When sashes are opened, uncovered area is automatically screened. Claimed to be valuable safety feature. Window also fitted with concealed window shade, said to save repair and replacement. Units will be available either in wood or metal and in sizes to suit every window need. Old windows may be modified to accommodate new design. — **The Reversible Double-Hung Window Corp., 103 Park Ave., New York City.**

★ ★ ★

LIGHTWEIGHT RESPIRATOR for protection against dust, pollen and certain bacteria, weighs 1½ oz. and excludes particles as small as a micron—1/25,000 in. Effectiveness, according to manufacturers, is due to four improvements: (1) New method of making

BLEACHER UMPIRES ARE OFTEN WRONG!

Near or far, anyone can guess. But the man who gives answers you can rely on is the dust-covered gent who stands right over the action.

The right answers are just as difficult in industry, as more exact manufacturing requirements add to friction's potential cost. And in the serious business of keeping down these costs, Shell men are succeeding daily by using the umpire's reliable system. They are constantly out on the job, working in your plants, getting their facts first hand.

That's why changes in design, speeds, pressures and other operating requirements of your machines don't take Shell men by surprise. They have seen those changes coming, months, sometimes years, before they arrived. And backed by the skill and resources of Shell research, they bring to new machines and old machines alike . . . in a wide variety of industries . . . lubricants that keep down costs from the day they go into service.

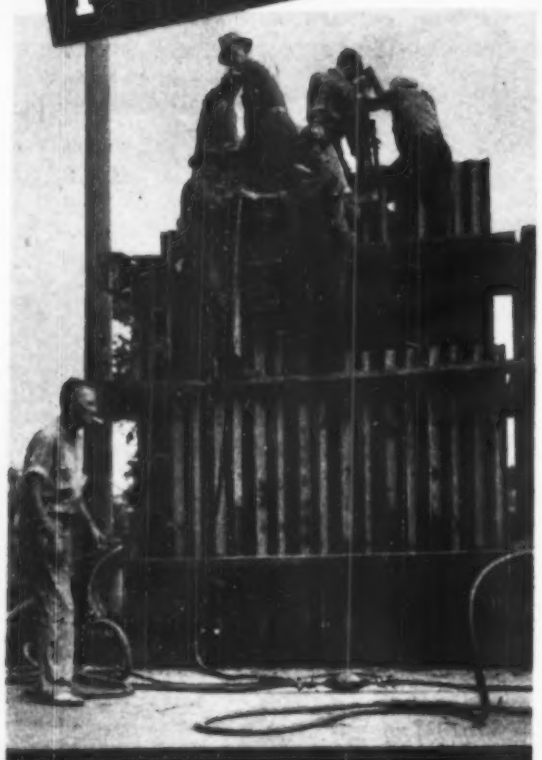
It's this "action-on-the-spot" method of getting the facts that pays off—and you are the one it pays. Have you had your Shell man's recommendation for your machines?

SHELL

SHELL INDUSTRIAL LUBRICANTS

THIS STURDY SHEETING

drives fast, pulls easy



Unskilled local labor was used to drive this ARMCO Sheeting on an important sewer project. Costs were low and the job was done quickly.

• You'll find some cost-saving possibilities in ARMCO Sheeting as compared to heavy, bulky timber sheeting.

For one thing, these sturdy metal sections are easy to pull and can be used again and again. This means you need less sheeting on large jobs. On small jobs you save by moving the sheeting from one project to another, thus reducing the cost of new material.

And ARMCO Sheeting is easy to handle. The corrugated design provides safe strength with no excessive weight. A small displacement area makes for fast, low-cost driving. ARMCO Sheeting can be driven to full penetration before excavation is started, thus speeding installation and lowering costs.

Three designs are available in a range of gages to meet different job requirements. You can buy the exact weight and type you need for trenches, cut-off walls, ditch checks, cofferdams and similar projects. Write for prices and complete information. ARMCO DRAINAGE PRODUCTS ASSN., 5054 Curtis St., Middletown, Ohio.

ARMCO SHEETING

filter unit, resulting in large filter area; (2) efficient exhalation valve; (3) self-equalizing, double headband which holds device securely against face; (4) facial design that assures comfortable fit. Said to be approved by U.S. Bureau of Mines for protection against inhalation of pneumoconiosis (silicosis and asbestosis)—producing dusts; and nuisance dusts such as aluminum, cellulose, cement, charcoal, coke, coal, gypsum, iron ore, limestone and wood.—**American Optical Co., Southbridge, Mass.**

★ ★ ★

20-TON ROTARY AIR MOTOR JACK, designed primarily for railroad service, is nevertheless said to be adaptable to many other uses. Features: (1) Speed—using 14-ton weight, shop test claimed to show that one man operating two of these jacks could raise and lower load in 4.3 min.; (2) ease of

operation—mounted on rubber-tired roller-bearing wheels, jack may be moved and placed quickly. Accurately timed lift permits one man to operate two jacks through Y-valve connection with quick, even raise up to its limit of 18 in.; (3) safety — when lifting standard reaches safe limit of raised or lowered position, motor automatically shuts off. — **The Duff-Norton Manufacturing Co., Pittsburgh, Pa.**

★ ★ ★

75 TRUCK MODELS for 1940 are offered by this manufacturer with tonnages ranging from 8,500 to 100,000 lb. gross vehicle weight and are available in all types, diesel and gasoline powered, conventional and cab-over-engine, four- and six-wheeler and shaft- and chain-driven. Of 40 gasoline powered models are listed ten 4-wheel conventional shaft-driven models 8,500 to 36,000 lb. G.V.W.; eight 4-wheel chain driven types, 20,000 to 60,000 lb., G.V.W. In conventional-type 6-wheel trucks are offered six 6-wheel, 4-wheel shaft-driven models, 22,000 to 55,000 lb. and one 6-wheel, chain-driven model rated at 100,000. In cab-over-engine models selection may be made from ten 4-wheel trucks ranging from 12,000 to 36,000 lb. and two 6-wheel, 4-wheel shaft-driven models rated at from 22,000 to 44,000 lb. Diesel powered trucks range from 219 to 519 cu.in. and are rated from 12,000 to 36,000 G.V.W. Of this

"YOU NEED A *Mall* GASOLINE POWERED VIBRATOR TO WIN AGAINST TODAY'S COMPETITION"

THE VIBRATOR THAT'S MAKING HISTORY IN SAVINGS ON TIME · LABOR · CEMENT · POWER

AND IN PRODUCING BETTER QUALITY CONCRETE

Contractors who are writing job-winning estimates that show a profit are figuring MALL Gasoline Powered Vibrators into their bids because these efficient units enable them to make every short cut that cuts costs. More than this, they give all types of concrete an increased density and water tightness . . . a greater compressive and flexural strength . . . a greater resistance to weathering, plus a better bond with reinforcement. They are foolproof, self-contained and operate without an air compressor or generator set.

Their variable speeds make them readily adaptable to many uses—CONCRETE VIBRATING, CONCRETE SURFACING, SAWING, FORM SANDING, PUMPING, WIRE BRUSHING, GRINDING, SHARPENING TOOLS and BITS, DRILLING in WOOD, BRICK, CONCRETE, IRON OR STEEL. A flexible shaft transmits the power to the vibrator which delivers 7000 vibration frequencies per minute.

Placing concrete in heavily reinforced sections on deck slabs.

Write TODAY for FREE demonstration and full information.

MALL TOOL COMPANY
7757 SOUTH CHICAGO AVENUE · CHICAGO, ILLINOIS

UNION FOR POWER

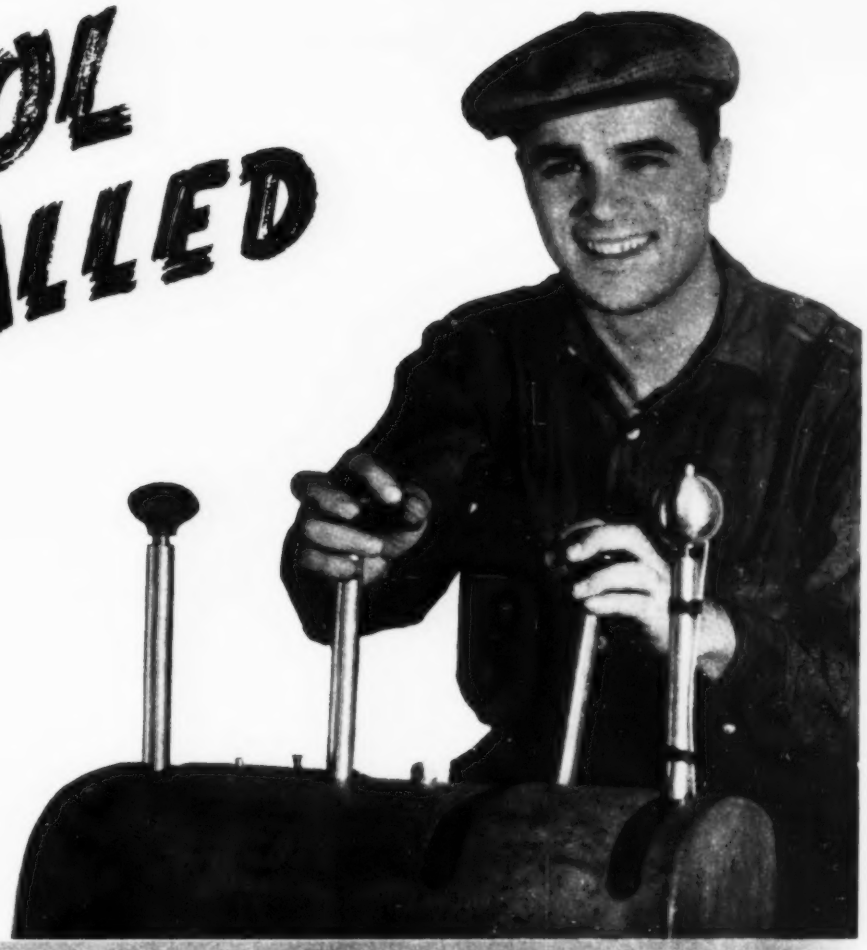
DRIVING 36" H-BEAMS *fast!*

• Here's a Union driving 36" H-Beams—and that is no small test of hammer POWER. Union Hammers in their various sizes handle ANY size job, because they're built that way. One-piece frame, no bolts, central-point lubrication—just 3 of many reasons. For steam or compressed air, no change of parts. Backed by 30 years experience.

UNION IRON WORKS, INC.
ENGINEERS & MANUFACTURERS
Spofford and Lidgerwood Aves., Elizabeth, N. J.

CONTROL NOT EQUALLED

by Any Other Excavator



Here's direct "feel" of the load at all times. Here's quick, cushioned response that protects against jerky operation and damaging jolts. And here's new ease of operation with a central control station where everything's reached as easily as the controls of your car — and no more physical effort is required.

The new P&H Excavator control — simple and dependable — makes possible new advantages for the owner, such as full floating brakes, automotive type clutches, electric dipper trip and other features that step up operations and knock down digging costs. This new control, offered on P&H ¾, ½ and ⅜ yd. machines, is fully described in Bulletin X-60. Write for your copy.

This P&H Model 100 (⅜ yd.), equipped with the new P&H control, is at work on a big sand-digging job. The owner reports that the machine recently completed 1500 hours of operation without a brake adjustment. Full floating brakes with full wrap bands make such outstanding records possible.

P&H Excavators are built in 18 different sizes, from ⅜ to 5 cubic yards capacity — gasoline, Diesel or electric power. Literature is available on all models.

P&H EXCAVATORS

General Offices: 4494 West National Avenue, Milwaukee, Wisconsin

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A Haiss Bucket is a Crane Man's Delight

Power to grab and "rassel" a boulder out of sticky clay .... Power to dig in any ground .... Power in its closing gear, power in its jaws and teeth, power in its Haiss-design. Write or wire for prices. All sizes.

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FOR PAY LOAD CLAMSHELL DIGGING

In stock at New York, Philadelphia, Baltimore, Birmingham, Atlanta, Hartford, Harrisburg & Los Angeles

GEORGE HAISS MFG. CO., INC., 139th ST. & CANAL PLACE, NEW YORK—DISTRIBUTORS EVERYWHERE

Post Office — Penns Grove, New Jersey
Foundation Contractor: Foundations, Inc., Moorestown, N. J.

"8 A. M.—Started to Pump . . . . . 2:30 P.M.—Job was Dry"

For satisfactory results at "Special Delivery" time, the contractor for the Penns Grove Post Office depended on a Moretrench Wellpoint System.

A good start on any job is half the battle. On a wet job it's often the *profits*. Start yours right with the finest pumping equipment made — MORETRENCH.

MORETRENCH CORPORATION

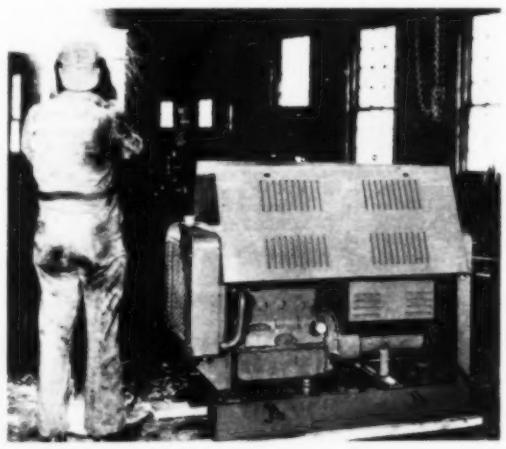
90 WEST STREET, NEW YORK

Plant: Rockaway, N. J. *Warehouses:* Joliet, Ill.; New Orleans, La.

type there are eight 4-wheel conventional, and eight 4-wheel chain-driven models rated from 20,000 to 60,000 lb. In conventional type 6-wheel models, are listed six 6-wheel, 4-wheel shaft-driven models, ranging from 22,000 to 50,000 lb., and one 6-wheel chain-driven model rated at 100,000. In diesel-powered cab-over-engine models there are ten 4-wheel models, 12,000 to 36,000 lb. gross range and two 6-wheel, 4-wheel shaft-driven models rated from 22,000 to 44,000 lb. All models except two smallest types are available as tractors. In addition to trucks and tractors, line includes two standard semi-trailer models featuring Mack co-incidental safety lock by means of which raising and lowering of support wheels automatically engages and disengages parking brake and also actuates secondary lock on fifth wheel, thereby said to prevent nose dives, dragging brakes and runaway trailers.—**Mack Trucks, Inc., Long Island City, New York.**

★ ★ ★

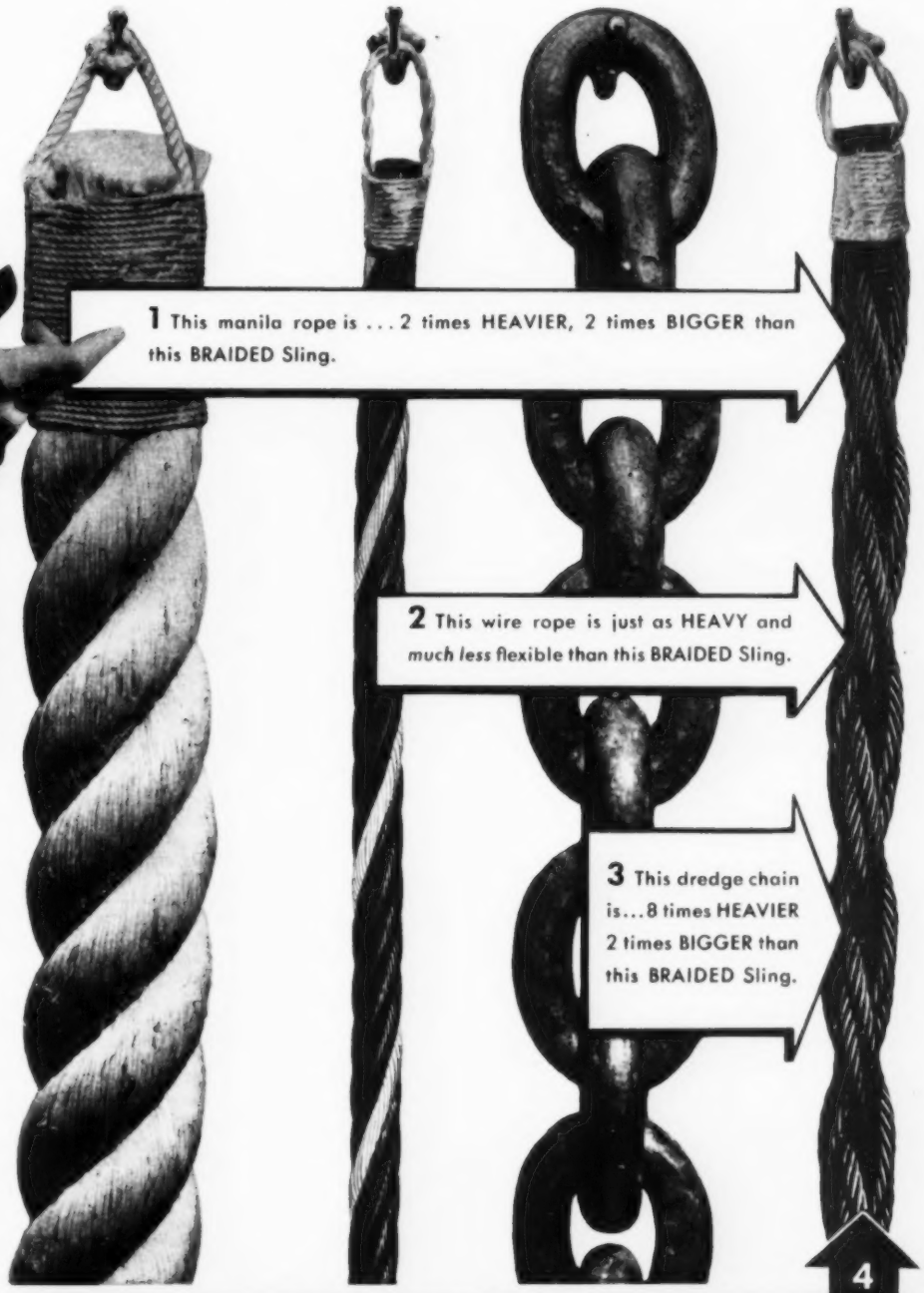
200-AMP. ENGINE-DRIVEN ARC-WELDER in stationary and portable models is said to be light enough to be wheeled readily by one man or lifted easily on its single balancing hook by average moderate-capacity chain or crane falls. Dimensions, stationary model: Length, over radiator grille, 56 in.; over hand crank, 63⅞ in.; width, 20¼ in.; height,



37¼ in. Portable model: same length as stationary type; width 27½ in. (wheel clearance) by 44½ in. high. Low price of unit said to place advantages of welding in reach of job welders, sheet metal contractors and light-metal fabricators. Welds light-gage metal by metallic arc process; repairs cast-iron parts, such as cylinder heads and blocks; does

hard facing; produces uniform current for welding of practically all metals and alloys with either bare- or shielded-arc type electrodes. Single-operator, variable-voltage type generator with laminated pole pieces. Current range, welding duty, 40 to 250 amp. Patented "dual continuous control" allowing independent adjustment of both open circuit voltage and welding current. Non-inflammable insulation. Continuous voltage and current controls make it possible to select any type of arc and any arc intensity to suit job. Powered by 4-cylinder gasoline engine 3x4-in. bore and stroke, piston displacement, 113 cu.in., delivering 26 hp. at 1,800 r.p.m. Fuel tank capacity, 8 gal.—**Lincoln Electric Co., 12818 Coit Rd., Cleveland, Ohio.**

this was news to me!


1 This manila rope is . . . 2 times HEAVIER, 2 times BIGGER than this BRAIDED Sling.
2 This wire rope is just as HEAVY and much less flexible than this BRAIDED Sling.
3 This dredge chain is...8 times HEAVIER 2 times BIGGER than this BRAIDED Sling.
4

Macwhyte Atlas Braided Wire Rope Slings, Known to Industry as THE Safety Slings . . . are

EASY TO HANDLE . . . because of their light weight and flexibility.

SAFE BEYOND COMPARISON... because the patented braided body is made from endless right and left lay wire ropes.

SPEED UP HANDLING... because they're so easily, quickly put around the load . . . and they "hug" it *tightly*.

ECONOMICAL? YES! Because they are labor saving, material saving, space saving, and time saving slings . . . built by men who are specialists at sling making.

RECOMMENDATIONS:

Write us today — Our sling engineers will study your lifting operations and be glad to make recommendations. **Their broad experience may pay you big dividends.**

MACWHYTE COMPANY • Manufacturers of Wire Rope and Braided Wire Rope Slings • Home Office: KENOSHA, WIS. New York . . . Pittsburgh . . . Chicago . . . Ft. Worth . . . Portland . . . Seattle . . . San Francisco . . . Distributors throughout the U. S. A.)

. . . Yet the ultimate STRENGTH of this BRAIDED Sling Is GREATER THAN the Manila Rope, Chain, or Wire Rope!

NO. 421

SIZE, WEIGHT, AND STRENGTH COMPARISON

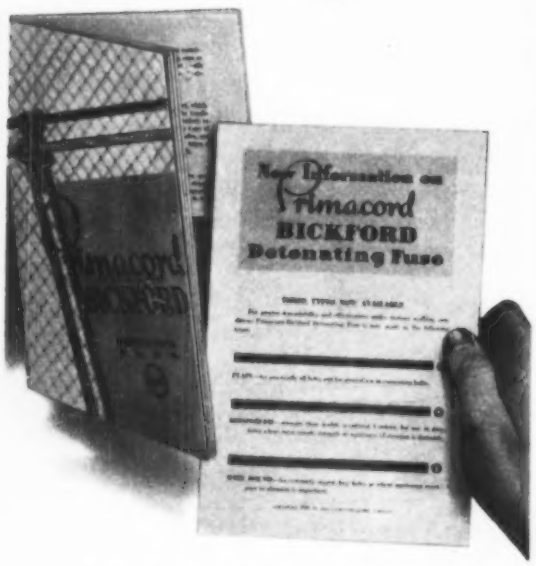
SLING BODY	MANILA	WIRE ROPE	CHAIN	ATLAS BRAIDED
OVERALL DIAM.	3"	3/4"	3 1/4"	1 1/8"
WEIGHT PER FT.	2.42 lbs.	1.23 lbs.	10.65 lbs.	1.28 lbs.
STRENGTH	30.5 tons	32.2 tons	31.0 tons	32.4 tons

Member National Safety Council

MACWHYTE ATLAS

Braided **WIRE ROPE** *Slings*

CHOOSE IT *right*



• Each of these three types of Primacord-Bickford Detonating Fuse has been developed to meet a particular need, as shown above. Check the job you have to do, and choose the right type of Primacord for that job.

Primacord carries a powerful detonating wave into each bore hole. Because Primacord is insensitive to friction, fire and ordinary shock, its storage, handling and hook-up are simplified; hazard reduced, economies effected, and greater efficiency obtained in large and intricate blasting operations.

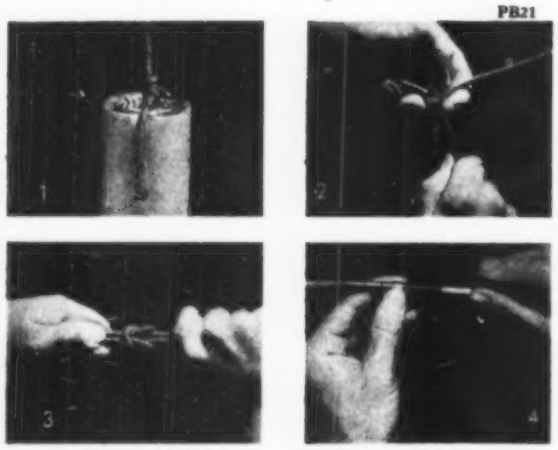
We'll be glad to send you full information.

THE ENSIGN-BICKFORD CO.
Simsbury, Conn.

Makers of Cordeau-Bickford Detonating Fus — and Safety Fuse since 1836

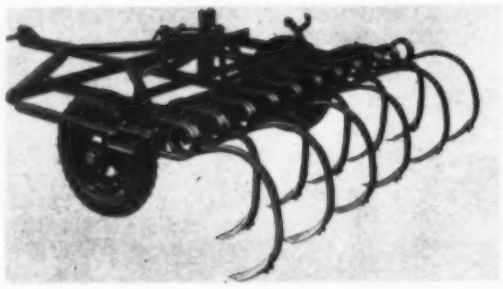
PRIMACORD-BICKFORD *Detonating* FUSE

PB21



1. Tie through cartridge.
2. Half hitch branch to main line.
3. Connect main line lengths with *square* knot.
4. Fuse and cap on end of main line.

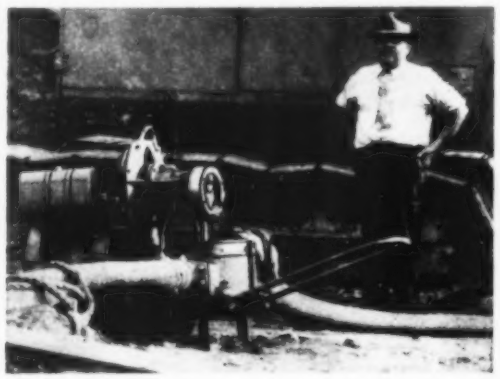
Important: Branch lines should lead away from main lines at *right angles*. Avoid kinks and small loops.



ROAD MIXING MACHINE now being used in many sections of country on soil-cement, road stabilization projects. May be had in two widths, 8 and 5 ft., and with pneumatic-tired or steel wheels. Pneumatic wheels available with Timken bearings or bronze bushings. Feature of machine is extra strong standards with double coil said to provide strength and flexibility. Points work to depth of 9 in. Used in conjunction with disk harrow, it is said to assure thorough mixing of soil cement materials.—**Killefer Mfg. Co., 5525 Downey Rd., Los Angeles, Calif.**

★ ★ ★

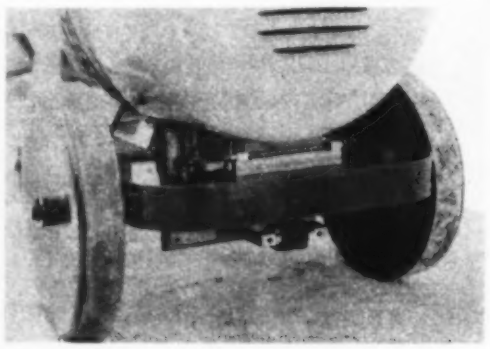
IMPROVED DIAPHRAGM PUMP offers following changes to increase efficiency and economical operation: (1) Power transmission and reduction accomplished by helical cut gears; (2) eccentric shaft is bronze bushed, said to cut down wear and ser-



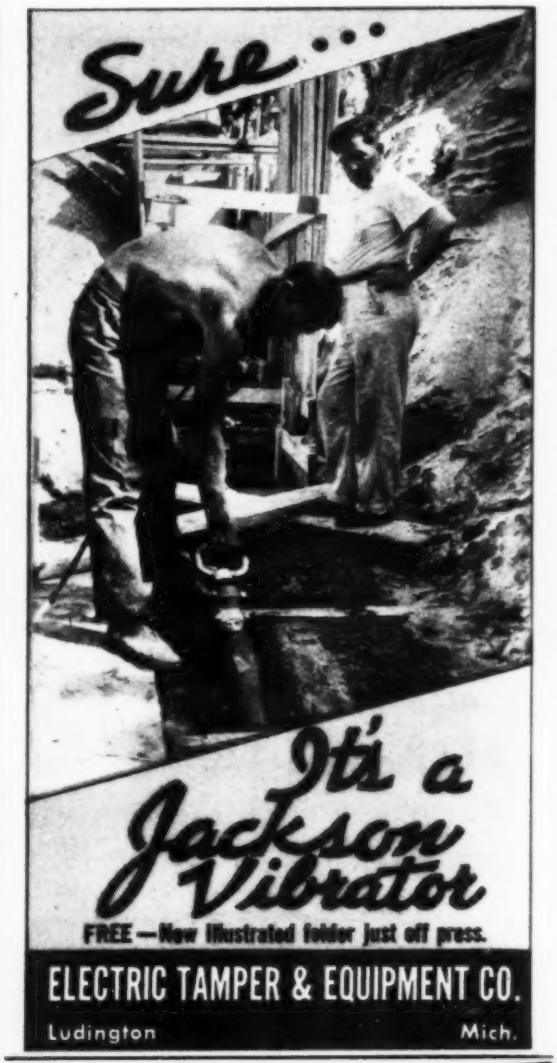
vicing and to allow economical replacement; (3) clean-out hand hole placed on suction side provides quick method of cleaning pump; (4) plate on clean-out hand hole secured by handle nuts which can be removed without use of wrench; (5) oil-tight gear case allows gears to be flooded with oil, said greatly to increase life of these parts and to reduce noise; (6) suction and discharge threaded on inside to receive full 4-in. connection allowing freer flow of water and increasing capacity.—**Novo Engine Co., Lansing, Mich.**

★ ★ ★

AUTOMATIC STOP-AND-START DEVICE for arc-welders was designed to eliminate waste incurred by frequent idling of machine between jobs. Using this device, operator starts welding unit by touching work with electrode holder. So long as he is welding, unit keeps running. When welding is in-



terrupted, machine automatically stops after time delay which may be set between ½ to 1½ min. to suit conditions of particular job. Time delay said to prevent undesirable frequent stoppings in case of tacking job. Device reconnectable for 220 or 440 v. or it may be supplied for other a.c. voltages (60 cycles only). For use on any magnetic starter, motor generator arc-welder, such as Wilson "Hornet," driven by a.c. motor — **Wilson Welder & Metals Co., Inc., 60 E. 42nd St., New York City**



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Ludington Mich.

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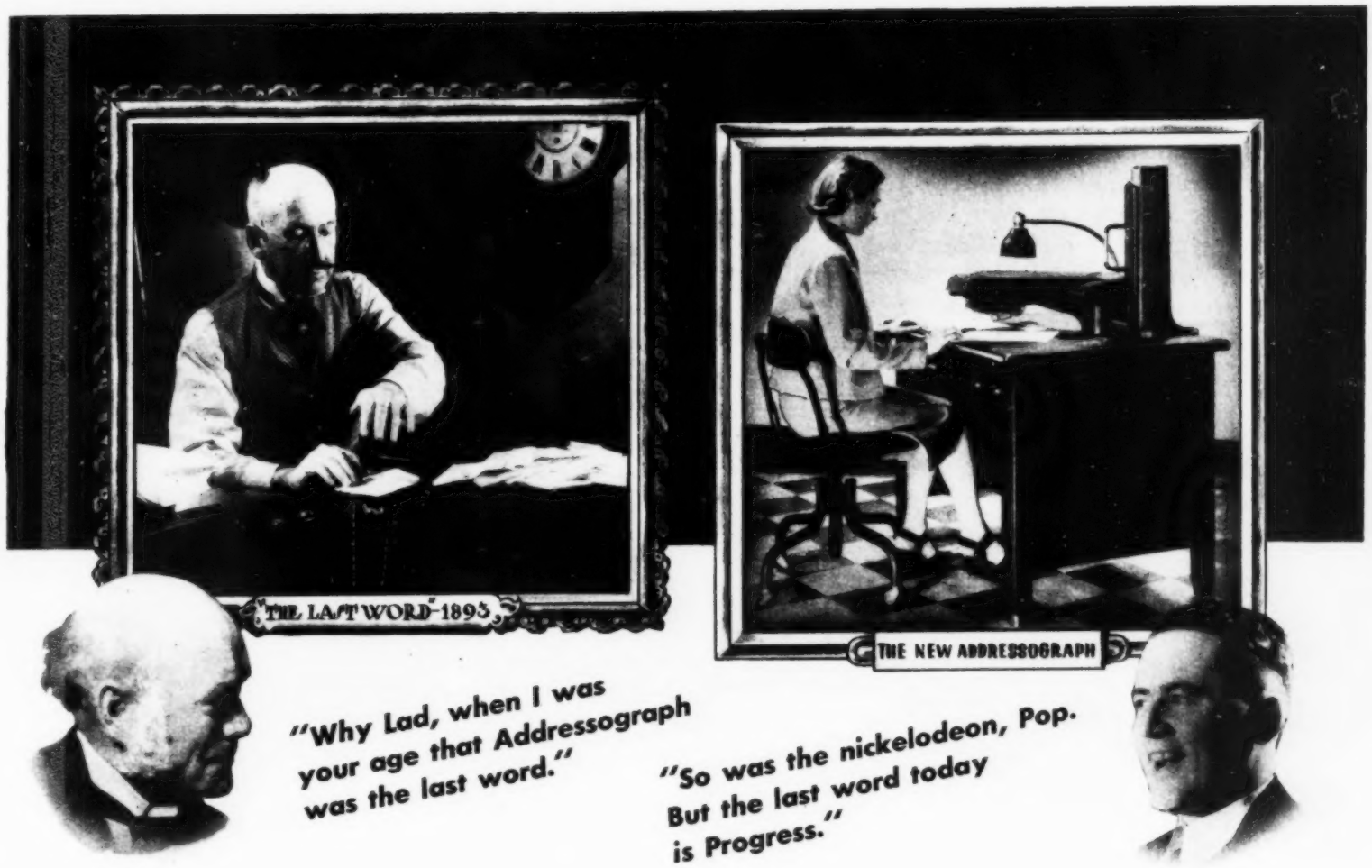
GIVES YOU *EASIER, FASTER,* AND *SAFER* CONSTRUCTION ON...

TUNNELS UNDER RAILROAD TRACKS

(above) One of five tunnels under N.Y.C., Main Line—Yonkers
(below) West Side Line Sewer—Bethlehem, Pa.—Dia., 5' 9".

• **When your contract calls for a railroad or street cross-under, don't go to the expense of laying sewers and water lines in an open trench . . . the COMMERCIAL LINER PLATE method has *proven* to be *easier, faster,* and *safer*. With circular self-supporting liner plates, the tunnel is "holed through" in short order. Consider the savings available with a COMMERCIAL "quick crossing" tunnel . . . then write for information concerning every application of COMMERCIAL LINER PLATES . . . they'll fit any size or shape of tunnel.**

***The* COMMERCIAL SHEARING & STAMPING CO.**
YOUNGSTOWN, OHIO



"Why Lad, when I was your age that Addressograph was the last word."

"So was the nickelodeon, Pop. But the last word today is Progress."

"Maybe, Lad, but that old 'Addressograph' was a humdinger. Just give her the gun and, presto, your envelope was addressed and the next name on the belt shifted into place. **THAT** was Progress, Lad!"

"Fine, Pop. But this new 'Addressograph' turns out pay-rolls, tax applications, billing forms and other records—and its welded steel printing arm puts it years ahead in speed and quality of work."

"You're prejudiced for welding, Lad. I'm from Missouri."

"I'm prejudiced for Progress, Pop. I can show you sharper, more uniform printing and 10 good carbon copies per impression where it used to be 3, because deflection of the printing arm has been cut from .018 inch to .003 inch by going to welded steel."

"I'd say that's arming for increased sales, Lad. But I'd like to see the model they bring out when you're my age. Bet yours of today will then bring on the smiles like my old timer."

"You'll see Progress a'plenty before that, Pop. Many designers are just starting to go places with welding."

"But suppose my route to Progress isn't via *increased rigidity* of a printing arm."

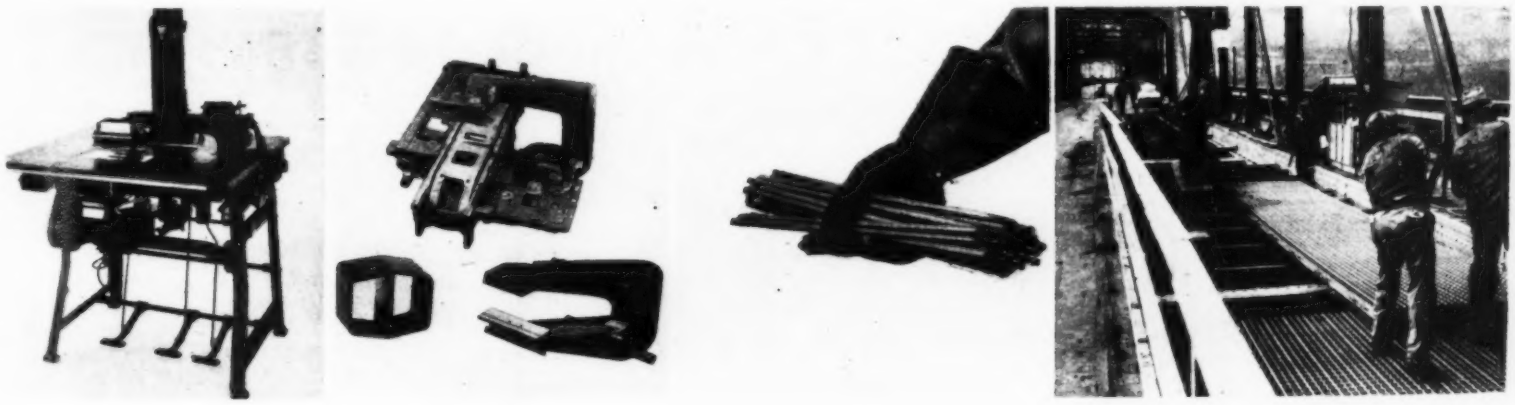
"OK. Suppose you're in the construction field. You can make headway via *stronger, stiffer buildings, bridges and other structures* and via *quick equipment repair for lower costs*. You can take the bee-line to Progress by lining up with the A-1 welding line of **THE LINCOLN ELECTRIC COMPANY**, Dept. F-25, Cleveland, Ohio. Largest Manufacturers of Arc Welding Equipment in the World."

FORMER MODEL. This "Addressograph" has been superseded by the streamlined, welded steel design shown. Parts such as the vertical magazine have been moved away from the printing path for greater operating speed and wider range of application.

1/6 THE DEFLECTION. Above: former cast iron printing arm and base assembly. Weight 170 lbs. Deflection .018 inch. Below: new welded steel printing arm and base unit with box section as shown at left. Weight 70 lbs. Deflection .003 inch.

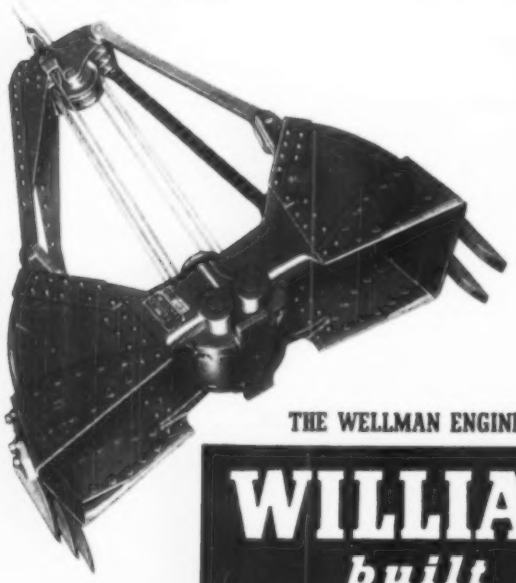
ELECTRODE PROGRESS. In line with Lincoln's progressive policy of ever reducing the cost of welding, this Company recently announced reductions up to ½c per pound for "Fleetweld"—the world's most popular welding electrode. Write for latest price list.

PROGRESS IN BRIDGE REPAIR. Here's new strength and safety for the Monessen-Charleroi (Pa.) bridge. Cross beams are welded to stringers. Grid type flooring is welded to beams. "*Shield-Arc*" Welders and "Fleetweld" Electrodes used 100%.



"THIS BUCKET SURELY DIGS"

• Two Williams Buckets are owned by George Slade, General Contractor, Bridgeton, N. J. About the rehandler bucket used to load crushed stone and slag into trucks, he writes, "It is a marvelous rehandling bucket. Two to three dips and the truck is gone."



About his ½ yard digging bucket, he says, "When it comes to excavating ditches, cellars and pipe lines, this bucket surely digs. We don't believe better buckets are built."

Send for free bulletins. They explain the fast, powerful action and rugged strength which make Williams Buckets so profitable to their owners.

THE WELLMAN ENGINEERING CO. • 7017 Central Ave., Cleveland, Ohio

WILLIAMS *Buckets*
***built by* WELLMAN**

Model 60 Schramm "Fordair" Compressor Mounted on Two Wheel Pneumatic Tired Trailer.

A NEW SCHRAMM AIR COMPRESSOR MODEL 60

FOR THE SMALL JOB OR A "CLEAN-UP" COMPRESSOR (AUXILIARY) TO FOLLOW THE LARGE MACHINE

OTHER MOUNTINGS TO SUIT EVERY CONDITION

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NEWS FROM MANUFACTURERS
About Their Products

The publications reviewed below, will keep you posted on latest developments in construction equipment and materials available for your use.

INTERNAL VIBRATORS—**Viber Co.**, 940 N. Orange Dr., Los Angeles, Calif. (16 pp., illustrated.) Lists uses and specifications of Viber vibrators, electric pneumatic and gasoline powered, rigid, semi-rigid and flexible types. General specifications: (1) Heat treated alloy steel construction with hardened outside surface, giving resistance to abrasive wear; (2) flexible casings fabricated from multiple laminations of special design steel wire braid, fabric and live rubber; (3) flexible cores of high quality steel designed for high speed; (4) Universal type electric motors, 110 v., a.c. or d.c.; pneumatic motors operating on 80-lb. air pressure; single-cylinder, four-cycle air-cooled gasoline motors; (5) motor bearings sealed and packed with lubrication at factory, requiring no further attention; (6) one-man operation.

★ ★ ★

PORTABLE ELECTRIC TOOLS—**Skilsaw, Inc.**, 5033 Elston Ave., Chicago, Ill. (51 pp., illustrated.) Complete line of portable electric tools, including latest models of hand saws, drills, belt sanders, hand grinders, disk sanders, blowers and floor sanders. Newest hand saw, Model 127, has 12-in. diameter circular blade for cuts 4⅜ in. deep, adapted particularly for heavy-duty timber cutting on docks, dams, bridges and railway maintenance-of-way work. Other saws with blades from 6 to 10 in. in diameter for form work, flooring, grooving and for cutting metal and tile blocks and terra cotta. Details of worm-gear reduction unit and other mechanical features. Radial arm available for mounting saw. Capacities of electric drills working on steel are from 3/16-to 7/8-in. holes.

★ ★ ★

TIMBER CONNECTORS FOR BRIDGES—**Timber Engineering Co.**, 1337 Connecticut Ave., Washington, D. C. (14 pp., illustrated.) Contains twelve typical timber highway bridge designs, result of a contest conducted by the company last year. Points out advantages and economy of timber bridges built with the connector system of construction. Structures with spans from 30 to 70 ft., designed for either H-10, H-15, or H-20 loadings are illustrated. Growing use of connector-built bridges is described and attributed to: (1) low first costs; (2) low maintenance costs; (3) simplicity of erection; and (4) use of fewer materials.

★ ★ ★

VIBRATING SCREENS—**Link-Belt Co.**, 307 N. Michigan Ave., Chicago, Ill. (20 pp., illustrated.) Vibrating screens for the effective screening of a great variety of materials, such as sand, gravel, cinders, grain, clay, crushed stone, coke, fertilizer, feldspar, coal, ore, etc.

★ ★ ★

SPRAY-PAINTING EQUIPMENT—**The De Vilbiss Co.**, Toledo, Ohio. (44 pp., illustrated.) Catalog covers in condensed form, complete spray-painting equipment for exterior and interior painting, automobile refinishing and equipment for automotive service as well as air and fluid hose. Will serve both as market guide and trade reference book. One page is devoted to safety equipment, respirators and goggles.

A REAL *Contractor's* POWER GRADER

★ Construction work has always demanded more in power and traction than conventional motor graders could deliver Either the work or the machine had to suffer!

With an A-W "99" Power Grader on the job you can tackle the toughest construction work from subgrade to clean-up with full confidence that it will be completed rapidly, efficiently and economically. All-Wheel Drive and Steer give this machine power and traction to spare for the hardest going . . . make it a practical tool for all sorts of jobs that usually require special equipment. Ask us to prove this. See the "99" demonstrate its distinctive qualifications that justify the title: "A Real CONTRACTOR'S Power Grader!" THE AUSTIN-WESTERN ROAD MACHINERY CO., Aurora, Illinois.

MAKES HARD JOBS EASY ... SAVES THE COST OF MANY PART-TIME TOOLS

Motor Graders • Blade Graders
Elevating Graders • Cable Scrapers
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YOU CAN BUY REX MOTO-MIXERS ON THE TIME PAYMENT PLAN!

• Now is the time to buy the truck mixer you need—now, when you can buy Rex Moto-Mixers on the time payment plan that allows 12 full months for you to pay for them! And look what your money buys—mechanical superiority that keeps Rex Moto-Mixer users in the "low bidder bracket": the Rex cone end drum, only one of its kind; the Rex one-man-end controls; the Rex zipper-type chute suspension; the Rex high discharge (jackass hoist) for greater spouting distances; and the exclusive Rex 3-point drum suspension that stops end play before it has a chance to start!

YOU GET all these features developed by Rex and proved best by hundreds of contractors and ready-mixed plant operators!

YOU PAY for them while you use them over a year's time. No large initial investment—chances are good that your Moto-Mixer earnings will help them pay for themselves!

See your nearest Rex dealer or write directly to our home office for complete financing details on the number and size of Rex Moto-Mixers in which you are interested! See how easy it is to buy, how profitable it is to own Moto-Mixers—the money-making truck mixers! Address the Chain Belt Company, Dept. MM-6, 1664 W. Bruce Street, Milwaukee, Wis.

SEND TODAY FOR DETAILS! BUY REX

MOTO-MIXERS AND BE RIGHT!

WROUGHT IRON FOR RADIANT HEATING—**A. M. Byers Co.**, Pittsburgh, Pa. (24 pp., illustrated.) Discussion of principles of radiant heating and reports on modern practice in installing such systems, using corrosion-resistant wrought-iron pipe. Examples include rooms heated with piping in continuous or grid coils embedded in floors, as was the case in the new office building for S. C. Johnson & Son (floor wax) in Racine, Wis. Notes on selection of pipe for radiant heating installations and on resistance of wrought-iron pipe to corrosion.

* * *

QUICK CLOSURES BETWEEN CASING AND PIPE—**Dresser Mfg. Co.**, Bradford, Pa. (2-p. leaflet, illustrated.) Describes new casing bushing, Style 83, for making closures between pipe and protective casing, such as is used under railroad tracks, highways, embankments, etc. Outlines advantages of product, such as elimination of pipe corrosion, absorption of vibration, protection of coating, elimination of open trench, easy assembly, and low cost. Four types available.

* * *

10,000-Ton Building

SIDE-STEPS STREET WIDENING

(Continued from page 53)

age rate of movement being about 3 ft. per hour. The jacks were reset after each 3-ft. shove. At the end of the 27-ft. move, heavy-duty jacks again were placed under the needle beams to release the rolling equipment and lower the columns on their new foundations.

Welded Brackets — Two ⅞-in. brackets, 21 to 26 in. deep, reinforced by ½-in. welded stiffeners, were welded to the flanges of each H-column. Edges of the column flanges had been beveled 45 deg. to ¼-in. depth to allow penetration of ⅝-in. fillet welds. Welded stiffeners also were used on the needle beams; for all this welding the Lincoln Electric Co. furnished the equipment and electrodes.

To pick up and carry the columns, the contractor used 90 tons of 9-ft.-long W. F. needle beams, 21-in. 68-lb. to 30-in. 116-lb. sections, and 100 tons of 18-in. 55-lb. I-section runner beams 25 ft. long. The 66 columns of the building were in 16 lines; to move the 16 lines required the laying of 7,000 ft. of 100-lb. rail in 32 double-rail tracks. For timber cribbing under the track and for incidental uses, the job was equipped with 6,000 6x8-in. blocks 40 in. long. In the moving operation the contractor employed 2,000 solid steel rollers, 3 in. in diameter by 3 ft. long.

Uninterrupted Use—Total contract time for the entire job, which involved 7,000 cu.yd. of excavation in addition to all the other work, was 120 days. During this time, 400 automobiles continued to use the garage, a bridge being maintained to con-

(Continued on page 88)

There Is NO Substitute!

for The Whiteman "Precision" Cement Floor Finisher

"PRECISION" FINISHED FLOORS at Less Cost Than Ordinary Floors

1. Absolutely Level Floors—
2. No High or Low Spots — No Riffles—
3. Uniform, Smoother Texture Throughout Entire Surface—
4. Dense, Strong, Wear-Resistant Floors—
5. Unequaled for Color Work— (Color is Pressed in Uniformly Throughout the Surface)
6. Leading (A. I. A.) Architects Specify: Mechanical Floated and "Precision" Machine Steel Troweled Floors—
7. The ONLY Machine That *Completely* Floats & Steel Trowels Cement Floors—
8. It PAYS for Itself—Right On Your Own Job—

Write Today for Name of Your Nearest Dealer

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3060 Glendale Blvd. Los Angeles, Calif.

STRENGTH

. . . to finish whatever it starts.

. . . to rip through toughest going.
. . . to ram the dipper deep into the bank.
. . . to resist twisting and fracturing.
. . . to absorb shock loads.
. . . to pile up profits for you.

11 Fully convertible models in 3/8-1/2-5/8-3/4 yd. sizes

BYERS

RAVENNA, OHIO

SPECIALIZING IN *Portable* SHOVELS AND CRANES

BETTER

rehandling BUCKETS

are being built . . .

BECAUSE of the exceptional ability of an Owen to get capacity grabs in shallow materials, the rapid dumping action of the specially curved shells and its quick clean-up ability, satisfied Owen operators all over the world join us in saying, "Better rehandling Buckets are being built and Owen is Building them."

The OWEN BUCKET Co.

6020 BREAKWATER AVE. CLEVELAND, OHIO

BRANCHES: New York, Philadelphia, Chicago, Berkeley, Calif.

AND OWEN *is* BUILDING *them*

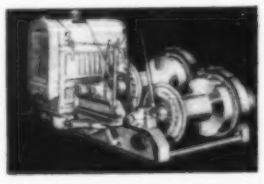
ONLY CMC OFFERS ALL THESE MODERN MIXER FEATURES!

Speed ON THE ROAD ON THE JOB!

You get big output with greatest portability in these trim, compact CMC two wheelers. Available in 5S, 7S, 10S, 14S sizes. Also four wheelers up to 14S — End Discharge and Side Discharge Models. A COMPLETE CHOICE to fit your needs, means time saved and extra profits.

LEFT — CMC Duas Prime Pumps. A complete line. Exclusive Twin Priming. Doubly fast—doubly sure.

RIGHT — New CMC Hoists. Low priced — high quality. Up to 40 H.P. Single and double drum.



Write TODAY for latest CMC catalog showing newest in Concrete, Plaster, Mortar and Bituminous Mixers, Pumps, Power Saws, Hoisting and Placing Equipment, Carts and Barrows.

CONSTRUCTION MACHINERY CO., Waterloo, Iowa

(Continued from page 86)

nect the doorway with the street. Other tenants in the building—mail and express offices and two stores—suffered no interruption in service.

Widening of Commerce St. is a PWA project directed for the City of Youngstown, Ohio, by Ralph W. O'Neil, commissioner of engineering. The Eichleay Engineering Corp., Pittsburgh, has played an important part in moving buildings for the street widening, which has been in progress for more than a year. For the corporation, John W. Eichleay and Philip M. Barnes are in charge of the moving work.

* * *

Wire Rope Slings

(Continued from page 58)

bight of the rope. These hooks are engaged in the chimes of the barrel and as a strain is taken on the sling, they are automatically pulled toward each other, thus assuring a firm grip on the load. For handling wood boxes, the bottoms of which cannot fall out, a sling of this type but with sharp pointed grab hooks (Fig. 8) is sometimes used.

For lifting loads which must be handled in a definitely level position, as for instance the top half of a steam turbine casing which must not be permitted to foul the blading on the rotor while being handled, a bar sling is sometimes used. This is usually provided with turnbuckles to permit the load to be carefully leveled (Fig. 9). Such slings are usually attached to lugs or eyebolts on the turbine casing.

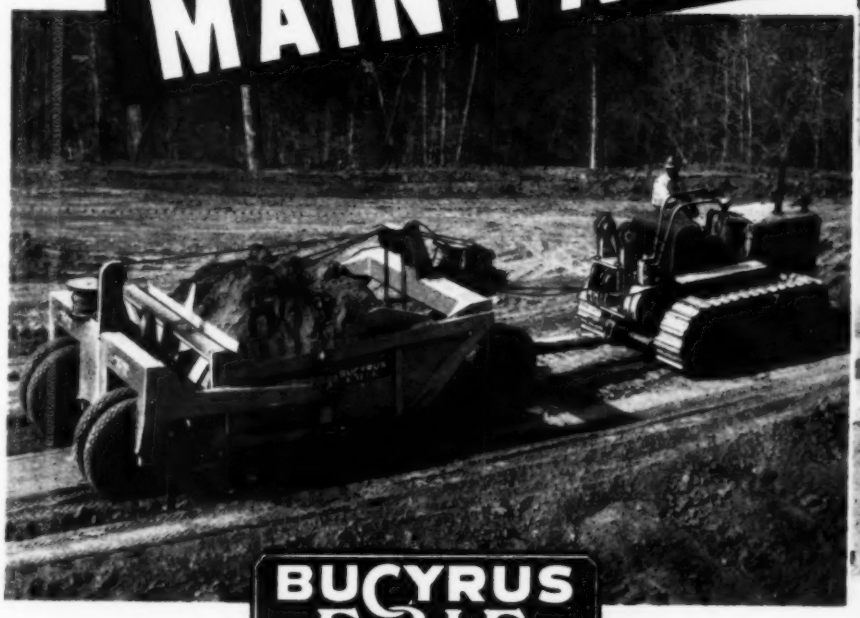
Hooks and forged eyes may be attached to the sling cable by various methods including eye splicing, spelter or babbitt socketing, a special swedging process where the cable is inserted into a hole in the shank of the hook or eyebolt and the metal cold worked into the recesses between the strands of the rope, by a hydraulic press (Fig. 10) or by a similar fitting swedged on to the rope by inserting it into a special clamp and applying the power of a blank cartridge to swedge it. If the surfaces of the load to be lifted are liable to cause abrasion to the sling, the latter is sometimes sewed with wire or inserted through ferrules for nearly its entire length.

Braided Slings

In recent years a type of wire-rope sling has been developed which is replacing many of the conventional types using the ordinary straight cable. This new type is the interwoven or braided sling made up of a number of smaller-size wire ropes, usually eight, but sometimes as many as 48 parts. In general, pairs of right-lay and pairs of left-lay ropes are used, these being

(Continued on page 90)

A scraper with only 5 MAIN PARTS



BUCYRUS ERIE

1 **MAIN FRAME:** The welded side plates of the strong main-frame unit extend ahead of the cutting blade to prevent side spillage both in loading and dumping.

2 **ejecting BOWL:** This simple double-thickness curved plate casting set a hinge behind the blade and gives positive rolling ejection for smooth accurate spreading.

3 **APRON:** The apron forms the forward part of the bowl and increases bowl capacity. The operator can see the loading and dumping action clearly at all times.

4 **REAR AXLE ASSEMBLY:** Low center of gravity and stable wheelbase give smooth accurate grading. You can dig, dump, or finish close to vertical banks and also on side slopes.

5 **FRONT AXLE ASSEMBLY:** Strong and well balanced, this front-axle assembly permits quick short turns within ordinary road grade limits. Handy hook-up to tractor.

Less Trouble
Less Time Out
Less Maintenance

FOR *Bucyrus-Erie* TRACTOR EQUIPMENT
SEE YOUR
International INDUSTRIAL POWER DEALER

Bucyrus-Erie
SOUTH MILWAUKEE, WISCONSIN

There's a Starr in this

Worms-Eye VIEW of a ROGERS TRAILER

●It illustrates engineering excellence based upon specialized experience.

Note the massive main-members — the sturdy center cross-members — the closely spaced outer-members.

Note, too, the liberal area of brake drums, the rugged rocking axle, the unrestricted oscillation that is possible, the Patented brake mechanism that gives dependable control at all times without "grab" or "brake walk".

Rogers construction will withstand the most searching scrutiny and the more thoroughly one investigates the more surely he becomes convinced that a Rogers Trailer represents outstanding value.

ROGERS BROTHERS CORPORATION
220 ORCHARD ST. • ALBION, PA.

EXPERIENCE • built it •
PERFORMANCE • sold it •

Greatest L+H* Capacity!

All Simplex Screw Jacks are *guaranteed* to **lift and hold* their full rated capacities, a quality not common to this type of Jack.

Advanced design and construction — a drop forged 9° floating cap revolves on a single large crome molybdenum steel ball which is nested in a hardened nickel steel ball seat. This construction centers and automatically aligns the load and reduces friction 88%. The heavy duty forged steel screw with cut acme threads provides easier, safer and faster lifting.

All popular sizes have tough malleable bases that eliminate breakage and reduce weight. The broad bell bottom base assures stability and the peephole provides safety against turning the screw out too far.

Thousands of Simplex Screw Jacks are in use on all types of construction and engineering work. They are made in 38 sizes with 4-way head and 19 sizes with ratchet type head for speed and operating in close quarters.

Sold by your supply house.

There's a Simplex Jack for every construction requirement—automatic raising and lowering jacks, trip jacks, journal jacks, geared jacks, pipe pushing and pulling jacks, concrete form jacks, special jacks and trench and timber braces. Become familiar with the entire line—they'll save for you!

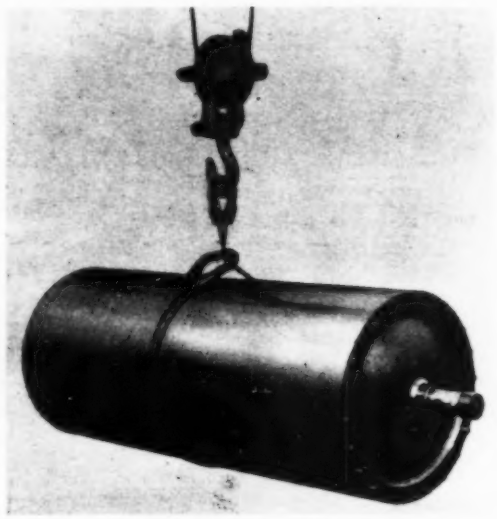
TEMPLETON, KENLY & CO., Chicago, Ill.
Better, Safer Construction Jacks Since 1899

SIMPLEX Jacks
Awarded the Gold Medal for Safety

Send For Simplex Bulletin Const. 39

(Continued from page 88)

spirally braided to form a flexible, non-kinking and non-spinning sling, the weight of which is only about one-quarter of that of a chain of the same capacity. The larger sizes containing a greater number of parts of rope, are usually braided around a hemp rope core or heart which acts as a cushion and assists in keeping the composite sling nearly round in cross-section. Even on the



STANDARD ANCHOR SLING of ½-in.-diameter wire rope (Roebling) with equalizing thimbles hoists 3,000-lb. paper dryer cylinder.

eight-part slings the spiral braiding gives a much lower modulus of elasticity than a single cable of the same capacity. This greatly reduces the stress on the individual wires when a load is applied rather suddenly, thereby increasing the safety factor.

Braided slings also are constructed so as to be almost flat in general cross-section. These are used particularly for basket-type hitches, especially when lifting heavy shafts. For this type of hitch, when the diameter of the object to be hoisted is very large, such as a locomotive boiler, a sling made up of a number of parts of wire rope wound back and forth between two heavy-duty thimbles is used. These parts of the rope are laid parallel to each other and are sewed at frequent intervals to bind them into one unit. Such a sling should never be bent around small diameters nor passed over sharp edges of the load.

All slings, of course, should be made of plow steel or improved plow steel rope, the latter identified by various trade names. All eye splices should be made by experienced splicers and should be sewed properly to conceal the sharp protruding ends of the wires which frequently cause injury to the riggers handling them. While not absolutely necessary it is good practice to place thimbles in all spliced eyes. Socketing, likewise, should be done only by experienced men. Care should be exercised when socketing not to allow the twist or lay to come out of the rope as it enters the throat of the socket. When not in use, slings should be hung up on special hooks or brackets to keep them as straight as practicable.

Special consideration should be given to

(Continued on page 92)

STOP BURYING DOLLARS...

RB POWER FINEGRADER

Under the Slab!

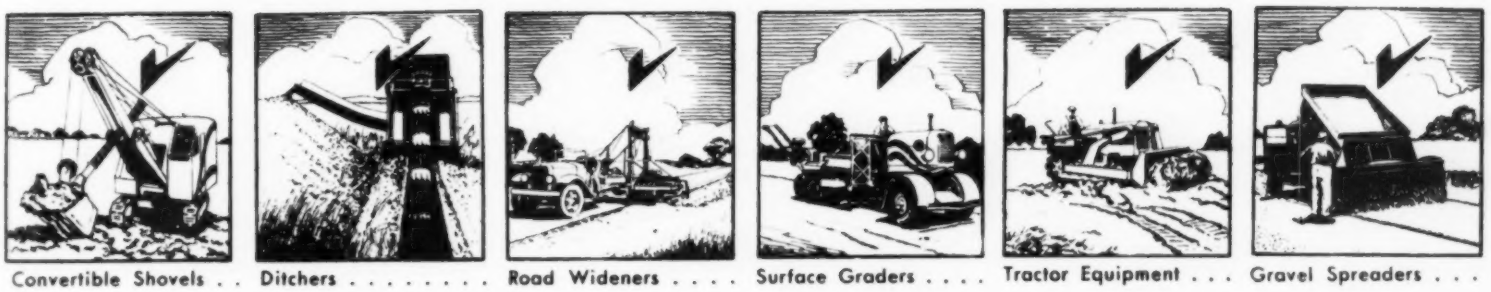
THAT'S what you're doing just as surely as you prepare the finegrade by inefficient, slow, costly hand methods. You're pouring dollars into the gradeline every time you cut too deep — every time you have to fill in low spots by hand, bring the grade up by trial and error — every time you hold up the paving crew while grade is being prepared — every time you pour extra slab to compensate for inaccuracies.

You can turn these wasted dollars into profits with an R. B. Finegrader — one pass and it cuts the grade *right to the payline,* even if the subgrade is roughly prepared — puts the right amount of material just where you want it on the shoulders — saves time, labor, material and money. Don't throw hard-earned cash into the ground. Put an R. B. Finegrader on the job. Write for Bulletin now! BUCKEYE TRACTION DITCHER COMPANY, Findlay, Ohio.

Another Money Maker— The Buckeye Spreader

Puts material right where you want it in accurately measured volume. (98-99% accuracy on many jobs.) Handles all materials equally well. Has spirally fluted, transmission driven feed roll that *grips* the material and spreads uniformly regardless of truck speed. Operates forward or reverse. Spreads close to roadside obstructions. Ruggedly built. Saves time, labor and materials. Pays for itself quickly. Write today for new Bulletin.

Built by Buckeye



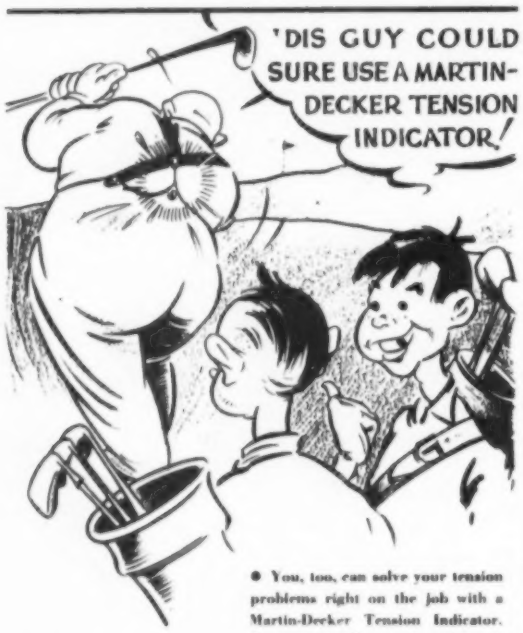
Convertible Shovels . . Ditchers . . . . . Road Wideners . . . . Surface Graders . . . . Tractor Equipment . . . Gravel Spreaders . . .

BEFORE YOU BUY IN "40" SEE THE REX TILTER

Here's the husky little brute that starts cutting costs even before it reaches the job. You'll find the Rex 3½S *tows faster—spots faster—charges faster—discharges faster*—than any other mixer in its class. And that all adds up to *more profit per yard*.

FREE—If it's profit you're interested in, you'll send for free Rex 3½S catalog before you buy a small mixer. Get your copy today. Address: Chain Belt Company, Dept. M-6-28, 1664 West Bruce St., Milwaukee, Wis.

REX MIXERS



● You, too, can solve your tension problems right on the job with a Martin-Decker Tension Indicator. Compact, simple, you just clamp it on the line and read the dial. It tells, under steady pulls or surging impacts, the *exact* load in pounds as it falls on the line. No *calculating . . . no deadending*.

With this information, you have a ready check on the line performance—on line efficiency, economy and safety—that will go a long way toward cutting maintenance costs.

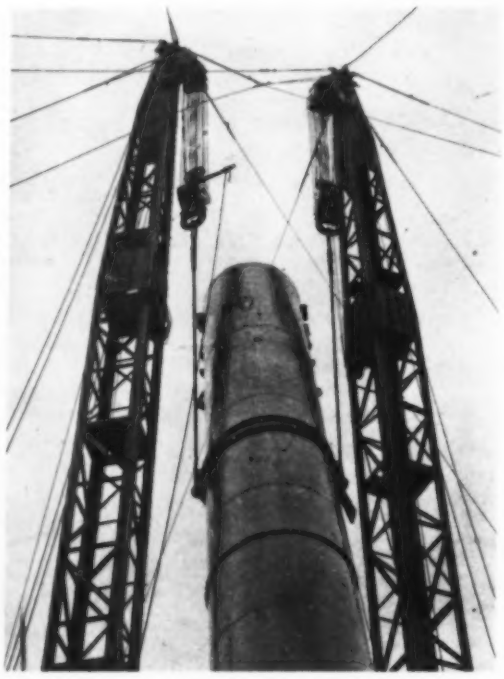
Martin-Decker Tension Indicators are available for all lines up to 2¼" in diameter, adjustable for temperature changes. Write for details, and also ask about the Martin-Decker Measuring Line Weight Indicator.

MARTIN DECKER CORP.
HOME OF THE WEIGHT INDICATOR
LONG BEACH CALIFORNIA

(Continued from page 90)

the angle which the legs of a sling make with the horizontal, as the lifting capacity is reduced much more rapidly than might be expected as the angle is reduced. For a single leg or part of the sling at an angle of 60 deg., the lifting capacity is only 87 per cent of that at 90 deg., or vertical; at 45 deg. it is 71 per cent, and at 30 deg. it is only 50 per cent.

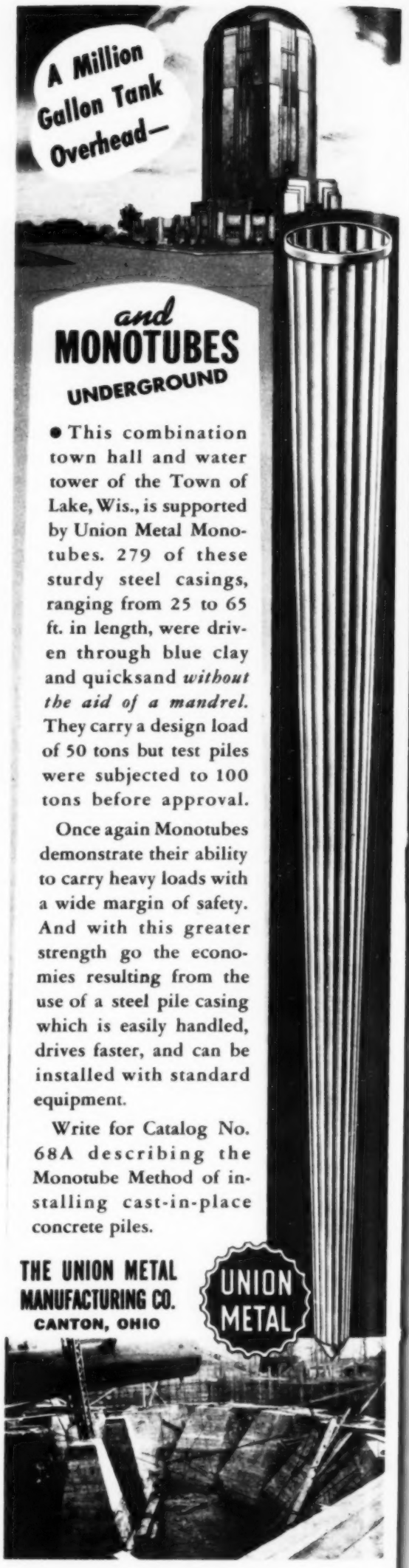
The accompanying table gives safe working loads, with a factor of safety of 5, for conventional wire rope slings, iron chain slings and Atlas braided slings, made by the Macwhyte Co. The loads for



TWO CHOKER SLINGS of 2½-in. wire rope (Broderick & Bascom) with 30-in. loops lift heavy steel tower

the single slings are self-explanatory. In the following three columns are given the loads for 2-way slings at various angles. For 3-way slings and 4-way slings these loads may be increased 50 and 100 per cent respectively. Theoretically, the basket hitch, as shown, should have twice the strength of the single sling, as there are two parts of it each having the strength of the single sling. In actual practice, however, the eyes at the ends of the basket sling are placed on the same crane hook, thus causing the legs of the sling to be considerably less than 90 deg. to the horizontal, which accounts in part for the reduction in strength given in the table.

Of course, slings should be inspected periodically and condemned when found in an unsafe condition. A few broken wires do not perceptibly weaken the sling unless located near the throat of a socket, in which case they may indicate fatigue of the metal of the rope. If crushed not too severely the strands may be hammered back into shape by means of a wood mallet and a wood block. Slings, regardless of type, should be protected from corrosion and from contact with injurious chemicals. With reasonable care a sling should last indefinitely and should be one of the safest parts of the hoisting equipment.



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CANTON, OHIO

UNION METAL

Wood Panel Forms

FOR BUILDING CONCRETE DAMS

(Continued from page 44)

they should be used wherever possible except, of course, in isolated parts of the work. During the course of the job, data regarding actual uses as compared with possible maximum use are important in maintaining control over actual field costs and effecting economies; these data are supplied to the superintendent by means of the cost report to be discussed later under "Cost Keeping."

How many panels shall be built? The answer depends upon the size of the job and the construction schedule. Properly designed panels are good for many uses, but it sometimes is necessary to construct more than otherwise would be required simply to keep the job moving at maximum speed.

Careful scheduling is of great importance if economy is to be obtained. On TVA dam construction jobs, the form schedule is prepared by the engineering forces. Sketches show all uses of panels and where the panels are to be moved after each use.

Design Elements

The designer of panel forms is confronted with a most important job. He is designing not merely for strength and economy of construction, but also for simplicity and economy of handling—elements that will be reflected in the formwork costs throughout the construction work on a typical project. Costs of erecting and stripping may exceed the cost of panel design and fabrication several times. In general, the ratio of the three principal components of formwork costs will be about as shown in the accompanying table *for each use of panel*:

MASS CONCRETE FORMWORK COST

	Per Cent
Panel	10
Field erection	80
Field stripping	10
	100

The percentages in the table apply to a job where a score or more of uses are obtained from each panel. Under any circumstances the designer could save only a few per cent of the total cost by efficient panel design alone, but he might, by insufficient study and experience, adversely affect the erection and stripping costs many times his claimed saving.

Data on panel design discussed in the following paragraphs have been obtained as the result of painstaking study collaborated in by construction engineers, superintendents and foremen. The form panels designed on the basis of these data exemplify some of the best practices of today.

Preliminary Considerations—In design-

(Continued on page 94)

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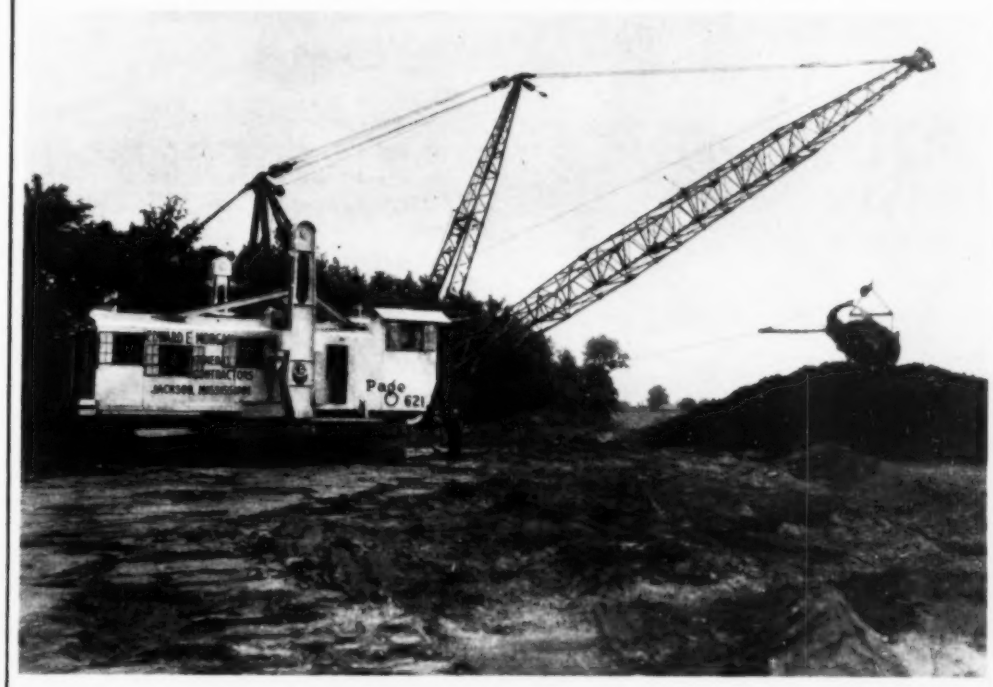

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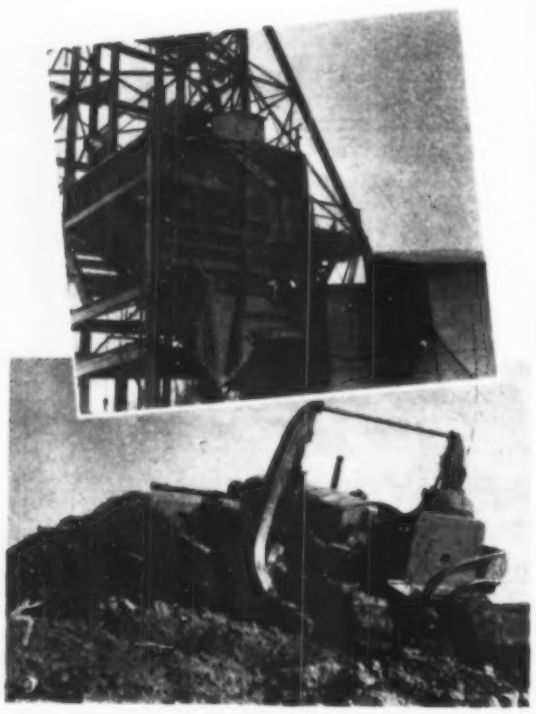

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(Continued from page 93)

ing forms it is first necessary to obtain some general information, such as the total area of surface to be formed, the type of form best suited to the job and to the handling equipment which will be available, the height of lifts to be made, desirable form heights and lengths, maximum capacity of the concreting plant, estimated average output of the plant, maximum average rate of rise of concrete in the forms, and the inside pressure of the fresh concrete against the forms, this pressure being determined from the expected rates of pour and the type concrete to be used. Choice of the best type of form depends somewhat on the preference of the men who are to use them. Both good and poor results have been obtained with practically every type form that has been used.

Certain features adaptable to most types of panel forms are becoming generally recognized as cost saving elements. Important items are:

(1.) Use of "single" panels in preference to "double" panels. The type referred to as single panels is defined as a panel which, after being raised, overlaps the placed concrete and is supported and anchored at its bottom by a bolt previously embedded in the lower lift. This type forms a single strip or belt around the block. The double panel type forms a double belt around the block; the lower belt incloses the previous lift while the second belt, resting immediately on top of the first belt, receives the next lift of concrete.

(2.) Using top anchorages for inclined ties rather than passing the inclined ties through the forms.

(3.) Adoption of fixtures with widely spaced threads to permit rapid erection and stripping of the forms.

Cooperation in Design

Close cooperation of designers and constructors can produce economy by eliminating difficult formwork or by increasing the height or size of monolith slightly to reduce the number of pours. Height of lift and locations of construction joints are generally determined in cooperation with the form designers for ultimate economy and the best effect on the finished structure. With the size of blocks known, the designer can determine the general type of form best adapted to job conditions and can then go to work on details.

To estimate the total number of panels required, it is first necessary to determine the number needed for a typical monolith and the elapsed time from placing concrete in one lift until the form is ready for reuse on the succeeding lift. This time can be ascertained for all lifts in a block, and an estimate can be made of the number of blocks on which forms must be in use at one time to keep concrete placing up to schedule. If the concrete schedule is stepped up during the course of the job, careful study should be given to the economy of making additional panels versus building forms in place for the extra pours.

Size and weight of panels and of assembled pieces of special forms will be determined from the type of handling equip-

(Continued on page 96)

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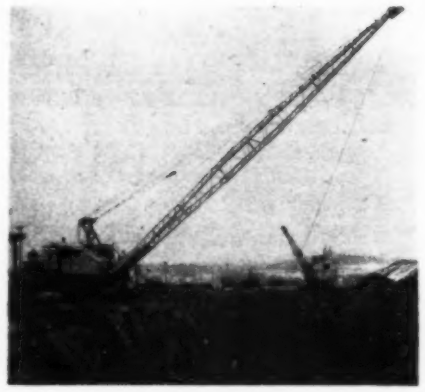

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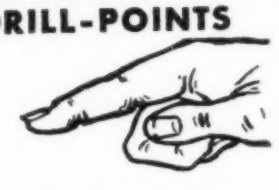

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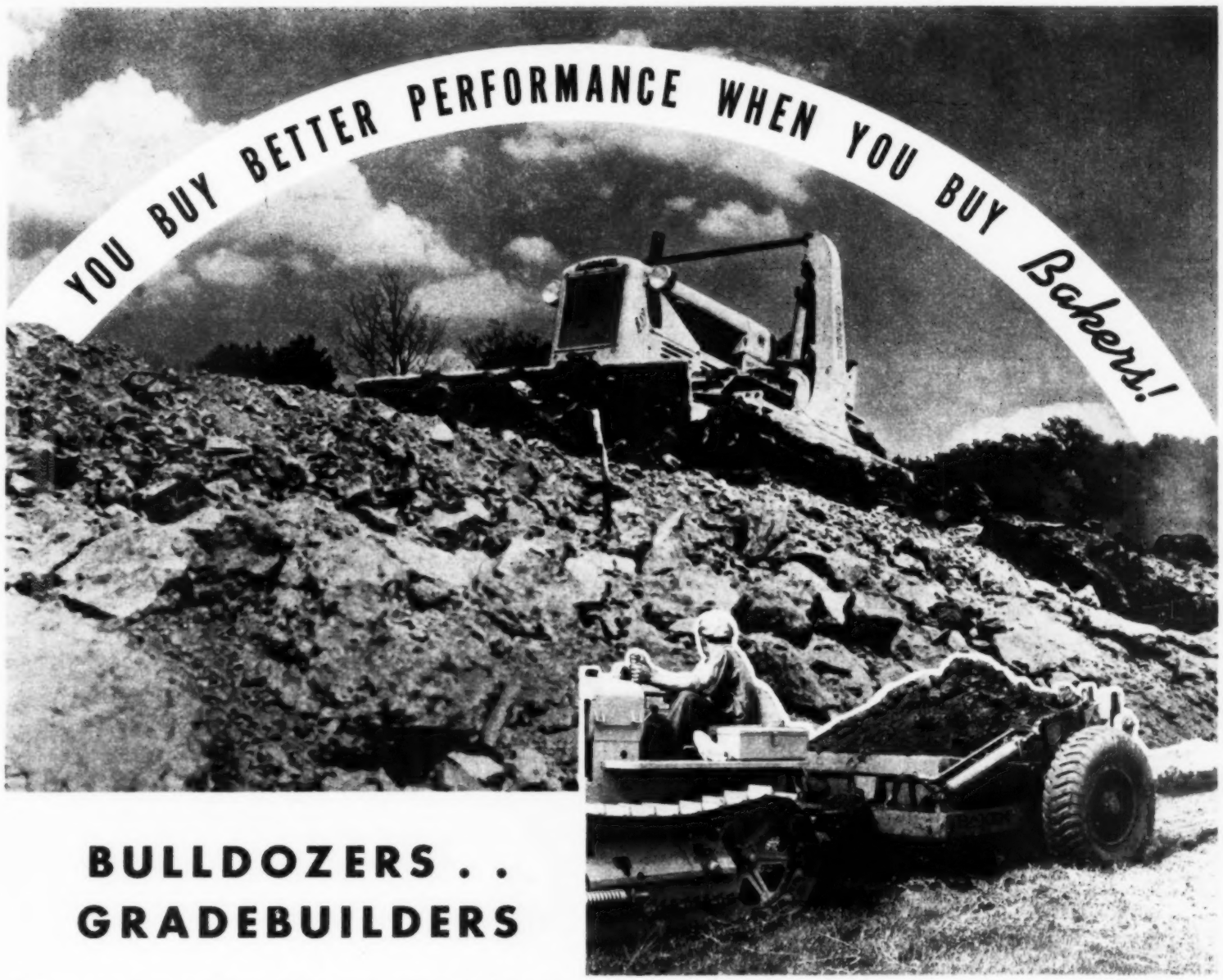

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(Continued from page 94)

ment available. If A-frames and hand-operated hoists are to be used, the form will not require the bracing and heavy hardware necessary for a large panel which is to be torn loose by a crane and often stacked on the ground before reuse. If a crane is to be used, the weight of the panel should be kept well below the rated capacity of the crane, as impact is likely to be high.

Pressure of Fresh Concrete on Forms

Tests have established the fact that the pressure of fresh concrete varies with the speed with which the forms are filled, the temperature of the concrete when placed and the type of mix. The type of mix determines the tendency of the concrete pressure to follow the line of increasing pressure of a fluid of the same weight as the concrete itself. The more fluid the concrete the more nearly the mix follows the line of fluid pressure.

Tests by H. G. Roby, published in *Civil Engineering*, March, 1935, indicate that an extremely rich mix will develop pressures from 40 to 60 per cent higher than a normal mix placed at the same temperature and rate of pour, that a lean mix develops pressures from 10 to 15 per cent less than a normal mix and that a dry mix develops pressures from 20 to 25 per cent less than a normal mix. The temperature of the concrete has an influence not only on the maximum pressure attained but also on the lapse of time before it is reached. Mixtures placed at 70 deg. F. develop maximum pressures equal to only 70 to 80 per cent of those developed by the same concrete placed at a temperature of 50 deg. F. and at the same rate of pour. These tests indicate that the maximum pressure attained must be affected by the initial set of the cement which in turn is speeded up or retarded by the temperature of the concrete.

An accompanying pressure curve, designed by H. W. Hunt and H. R. Kinzer, can be used conveniently by the experienced form designer to determine maximum form pressures within the range and conditions indicated on this chart. Because pressures are affected by the type and consistency of concrete, by the temperature and by the placing rate, it is not reasonable to expect one set curves to fit all conditions of placing; allowances and compensation must be made to care for variations in local conditions.

Basic data for the upper portions of these curves, above the points of maximum pressure, were taken from tables compiled from tests made by the U. S. Army Engineers. The line of increasing pressure, or the line of fluid pressure, was reduced, however, from 150 lb. per sq.ft. to 140 lb. per sq.ft. to make the data applicable to low-slump concrete used in large forms. At the points of maximum pressure, the Army Engineers' data were abandoned, and the curves were completed by using data obtained from curves published in the Portland Cement Association publication, "Forms for Architectural Concrete." Only pressures for concrete placed at 70 deg.

(Continued on page 98)

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(Continued from page 96)

and at 50 deg. were given in this publication; with these data as guides, the lower portions of the curves for concrete placed at 80 deg., at 60 deg. and at 40 deg. were interpolated. A comparison of the tests from the two sources indicated that the two sets of curves could be tied together at the points of maximum pressure with a reasonable degree of accuracy.

It must be pointed out that these curves are based on the static pressure of the concrete alone and do not take into account the impact produced by instantaneous dumping of buckets or height of fall of concrete. Within limits this local impact loading will be absorbed by the factor of safety of four or more recommended in design stresses and need not be considered for theoretical deflection of the members. It is important in anchor bolt and rod design that good judgment be used with the theoretical charts to provide safe ties that will not slip or stretch.

Effects of Vibration

Where vibrators are not used the concrete at the bottom of the form solidifies, becoming self-supporting and the resultant pressures are similar to those shown on the accompanying pressure curves. Where vibrators are used in narrow forms which are filled rapidly, the pressure for all practical purposes may be considered as fluid for the full depth of the form.

Tests made at Pickwick Landing dam by H. T. Lofft with Goldbeck cells indicate that vibrators have less effect on large forms than might be expected. These tests showed that vibration did increase the pressure on the cells, especially where the vibrator was used in concrete that had been in place for 30 min. or more. In actual practice, however, the normal operation was to place the vibrator in a freshly deposited concrete batch which, being quite plastic, practically absorbed the vibrations.

Form Lumber—Douglas fir is one of the most common types of lumber for form panels. On TVA jobs, southern yellow pine is almost exclusively used. Southern Pine Association grade rules are divided into three general classes: (1) Longleaf; (2) Shortleaf; and (3) Yard lumber and shed stock. Each of these classes is subdivided into grades according to size and number and location of defects such as knots, shakes and checks.

It has been determined that the strength of pine is very closely related to its density, and a density provision should be included in specifications for lumber and timber used for carrying known stresses. Longleaf pine has greater resistance to decay than the other southern pines, but generally the 25 to 40 per cent higher cost of longleaf is not justified for construction work.

The "Dense Structural Square Edge and Sound" grading may be used for panels and for reusable studs and wales. For miscellaneous use, Dense No. 1 Structural will be satisfactory.

For example, the Hiwassee dam project specified the following for form lumber: *Sheathing*—1½x6 in., random lengths, 12 to 18 ft., No. 1 dense shortleaf sheathing, machined with tongue off center and select

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side adjacent to long shoulder; S2S, standard dressing, air dried.

Studs—4x8 in. dense structural square edge and sound shortleaf joist and plank, S2E, standard dressing, air dried.

Wales—6x6 in. and 6x8 in. No. 1 common utility timbers S2E, standard dressing, air dried.

Sheathing invariably should be not more than 6 in. in width; 4 in. is better in order to maintain a true surface on the panels and to simplify repairs. Special surfacing of panels with steel plate or plywood often causes water to run along the smooth face of the forms before the concrete has set, leaching out the cement and developing sand streaks which deface the surface of the structure.

Thickness of sheathing generally is between 1½ in. and 2 in., depending upon stud spacing and maximum allowable deflection which, in general, should not be great enough to be noticeable.

Tongue-and-groove sheathing is commonly used, especially on exposed surfaces, to obtain a smooth surface and watertight form. The chief objection to tongue-and-groove lumber is the slow and expensive operations involved in making repairs; a further objection is that the edge of the groove is likely to split off. As an alternative some superintendents advocate the use of S4S sheathing 1½ in. thick, which is so flexible that all warps and crooks can be drawn out with nails, resulting in a good tight form. This type of lumber not only reduces repair costs but also is easier to work and gives as good surface finish as tongue-and-groove sheathing.

Allowable Stresses in Timbers

Formwork, being temporary, may be designed for somewhat higher working stresses than would be allowed in permanent construction. It is not advisable to go to extremes, however, because forms may be overloaded as a result of unexpectedly rapid rates of placing, of surge due to dumping of large buckets of concrete or of other construction conditions.

For southern pine as discussed above and for Douglas fir, generally used for forms, an extreme fiber stress of 1,200 lb. per sq. in. should not be exceeded in panels and 1,800 lb. per sq. in. in built-in-place and special forms. In panel forms, the maximum allowable safe shearing stress is 125 lb. per sq. in., but for built-in-place and special forms this stress may be increased to 150 lb. For bearing or compression perpendicular to the grain, 400 lb. per sq. in. may be used.

Allowable irregularities in finished surfaces of concrete depend upon the finish desired, upon the location of the concrete in the structure, and upon whether or not appearance is the controlling factor. For reusable panel forms, the form design should prevent any deflections which would be objectionable from the standpoint of appearance.

★

NEXT MONTH:—**Part 2 of this series, to be published next month, will continue the discussion of principles of panel form design and will be followed by other chapters on shop fabrication, handling of forms in the field, time studies, and methods of cost keeping.**

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"VULCAN" CLAMP KIT VISE. This latest addition to Williams' line is identical in design with "Vulcan" Vise No. 1, except that a clamp member, integral with the base, has been incorporated. The vise can be readily and firmly attached to bench, post, or other support without use of bolts, or screws. Light weight, only 5¾ lbs.— easily carried. One size for pipe, ⅛ to 2".

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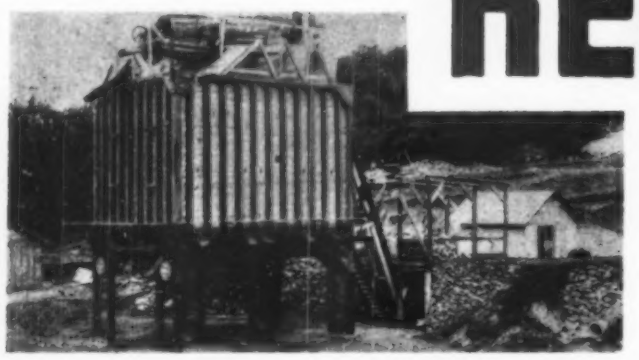

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Maine Tests Admixtures IN CONCRETE PAVEMENT

(Continued from page 51)

by the State Department of Health. Consistency of the mix was controlled by slump tests.

Concrete Slab—The 12-ft. concrete widening strip is of thickened-edge design, 9-7-9 in., with double steel mat reinforcement amounting to 9.891 lb. per square yard and with expansion joints at 40-ft. intervals. Concrete was placed on a gravel base varying in thickness from 8 to 12 in. For about 3.6 mi., the project has concrete curb with catch basins and storm sewer, much of the latter consisting of perforated pipe in trench backfilled with crushed stone, to serve also as an underdrain. On other portions of the project, drainage is provided by side underdrains and by open ditches. Grade of the pavement ranges from level to a maximum of 7 per cent.

Of a total of 8,000 cu.yd. of concrete involved in the project, about 27 per cent was mixed with regular portland cement, and the remainder was divided roughly as follows: 26 per cent using 1 part natural cement to 5½ parts portland cement, 27 per cent using 0.05 per cent vinsol resin and 20 per cent using 0.03 per cent vinsol resin.

Construction Observations

Blending portland cement with either natural cement or vinsol resin speeded up the progress of the work, and finishing was completed in shorter time than on pavement using regular portland cement. The batchmeter setting on the mixer was the same for all types of cement, regular or blended. Average progress by the contractor on the experimental project was about 370 cu.yd. per day.

Natural Cement Admixture—Portland cement and natural cement were blended on the job in the proportions of 5½ parts portland to 1 part natural. The effect of incorporating the natural cement was to reduce the density and increase the cohesiveness of the mixture. Water gain on the surface was largely eliminated. The compressive strength of the concrete was less than that of the regular portland cement concrete.

Vinsol Resin Admixture—Vinsol resin in two different percentages was ground with portland cement at the mill. The effect of the vinsol resin was to increase the air content of the mixture; other effects were similar to those of natural cement. With 0.05 per cent vinsol resin, considerable stripping of coarse aggregate occurred; with 0.03 per cent vinsol resin, little stripping of coarse aggregate was apparent. Water gain on the surface dur-

(Continued on page 102)

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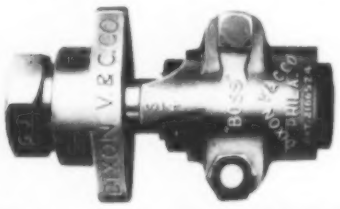

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The safest and most efficient couplings for air hose service. Same construction as "GJ-DIXON" Couplings described above, except that they are equipped to withstand highest pressures and roughest handling, by application of sturdy malleable iron "BOSS" Clamp, fingers of which are gripped tight to collar on coupling stem. No possibility of blow-offs. Cadmium plated—rustproof. Compact type, Style XLB-81, ½" and ¾"; heavy type, Style XHB-72, ¾" and 1".

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Same general design and construction as "DIXON" Air Hammer Couplings, except that, like the "GJ-BOSS", they are furnished with the strong, malleable iron "BOSS" Clamp, to insure maximum safety and efficiency under all conditions of air hose service. Cadmium plated—rustproof. Compact type, Style WLB-21, ½" and ¾", heavy type, Style WHB-32, ¾" and 1".

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(Continued from page 100)

ing the finishing process was largely eliminated with both percentages of vinsol resin. The compressive strength of the concrete was less than that of regular portland cement concrete.

Records — An identification mark was scratched into the concrete of every fifth slab for convenience in future studies. Locations of all changes in mixtures and variations in grading of fine and coarse aggregates were carefully noted. Records of each slab show the time the concrete was placed, the mix used (including gallons of water per cubic yard), amount of finishing, and the time spent in each operation until curing was completed. A record of temperatures was obtained from a local airport.

Future Studies—As the project was just recently completed, practically no information in regard to durability of the pavement is available at present. With the assistance of the comprehensive records of various mixtures and construction details, it is expected that future studies of the test road will yield information of value.

For the State Highway Commission, the work was carried out under the direction of Lucius D. Barrows, chief engineer.

* * *

Rock Drilling Practice AT STANISLAUS TUNNEL

(Continued from page 65)

In the month of September, the total time taken to put in a round was 3 hr. 18 min. with a 33-man crew. This time was reduced to 3 hr. 2 min. in November by the increased efficiency of the men and by the addition of two men to bring in the drill carriage and set up the drills. By January, however, the time to put in a round had increased to 3 hr. 48 min., due in large part to the fact that the headings were more than a mile apart and the time consumed in moving men and equipment from one heading to the other had increased from 6 min. to more than ½ hr. With a crew of 36 men, it required 133 man-hours for each round.

Early in January a second crew was added and each crew of only 26 men worked in a single heading. One of the tables shows the average time taken for a round under the single-heading method of operation. The man-hours per round in the east heading dropped to 127, a saving of 6 man-hours. In the west there was a rise to 144 man-hours, but this was due to encountering harder rock and not to the change in method of working.

The most economical depth of drill hole

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in an unlined rock tunnel usually is the longest round that can be pulled without excessive over-break. This is due to the fact that the time taken to set up the drills, load, blast and clear the heading of gas is the same regardless of the length of round. On the Stanislaus tunnel, this time amounted to 51 min. per round or from 25 to 28 per cent of the time taken for the drilling operation.

The length of round that it is physically possible to break is limited by the size of the tunnel and the breaking quality of the rock, while the economical length is limited by the fact that the quantity of explosive used per cubic yard increases with the length of round. The well known rule-of-thumb for determining depth of drill holes is that the depth shall be two-thirds the longest dimension of the tunnel —in this tunnel ⅔x11.25 or 7½ ft. Accordingly, a 7-ft. round was tried first, but after a few weeks it was found possible to gain speed and economy by increasing the round to 9 ft. Finally the rounds were standardized with a length of 9 ft. in one heading and 10 ft. in the other.

This difference between the two headings was maintained to reduce waste of drill steel. As drill steel is used, it wears shorter. After 6 in. have worn off, it must ordinarily be cut down 18 in. to fit the next shorter size. In this case, however, when a

ACCIDENT COSTS IN PER CENT OF TOTAL LABOR COSTS

	SECT. 1	SECT. 2	SECT. 3	TOTAL
Drilling and blasting	9.47	4.98	3.33	5.90
All underground labor	6.89	5.06	3.59	5.14
Installation, operation & maintenance of driving plant				3.34
Total driving tunnel				4.96
Miscellaneous construction other than tunnel driving				2.62
Total direct labor				4.82
Total, including camp, general plant, job overhead				5.26

10-ft. drill in use in one heading wore to 9½ ft., it was necessary to cut off only 6 in. and transfer the 9-ft. drill to the opposite heading, a saving of 1 ft. of steel in each cut.

The actual advance per round varied from day to day with the character of the rock. Average advances for each section are tabulated. These tables also give the amount of explosive used per cubic yard, indicating a larger consumption for the longer rounds. The increase is not due entirely to the longer round, as the rock in those headings showing greater consumption of explosive was harder to break. The standard round was shortened occasionally, either when the rock was so hard that it was not possible to break a full round, or so soft and seamy that a long round caused excessive overbreak.

In spite of these long rounds, the sides of the tunnel were remarkably smooth, without excessive, rough overbreak, as

(Continued on page 104)

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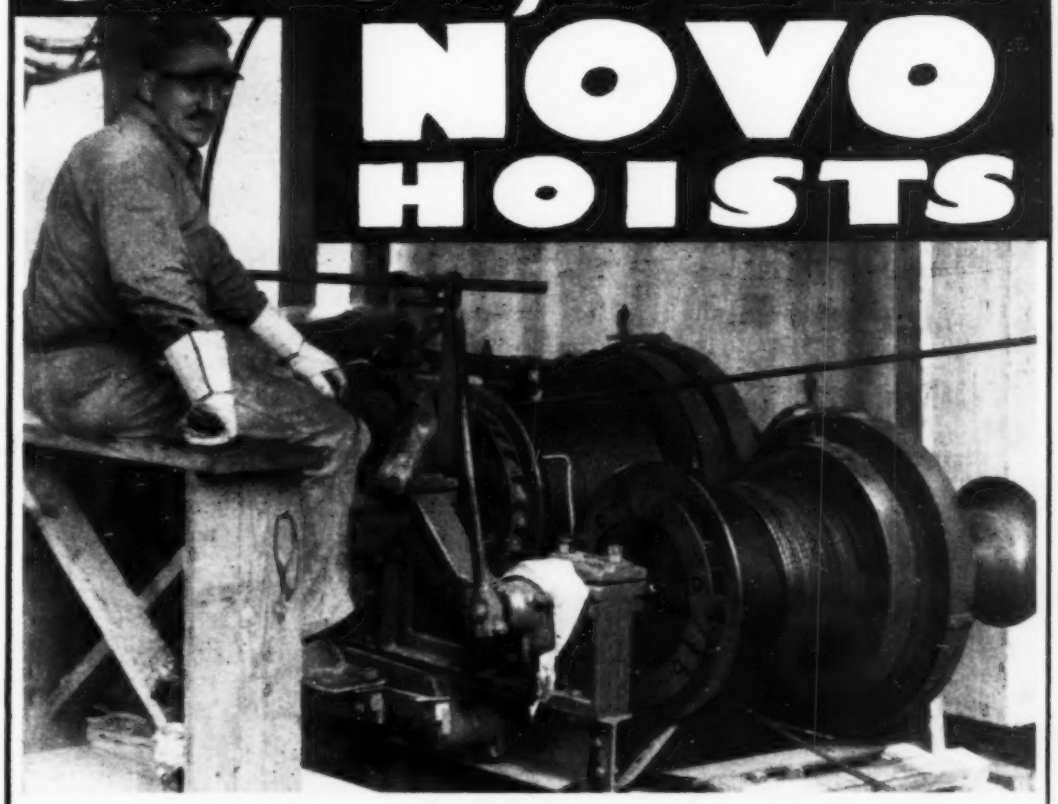

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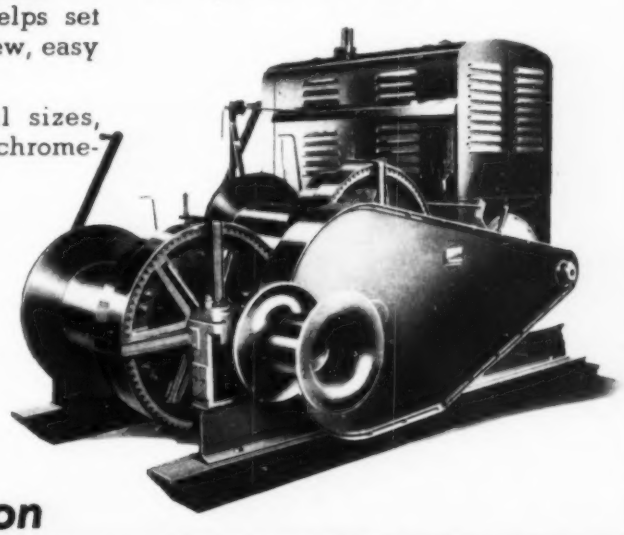

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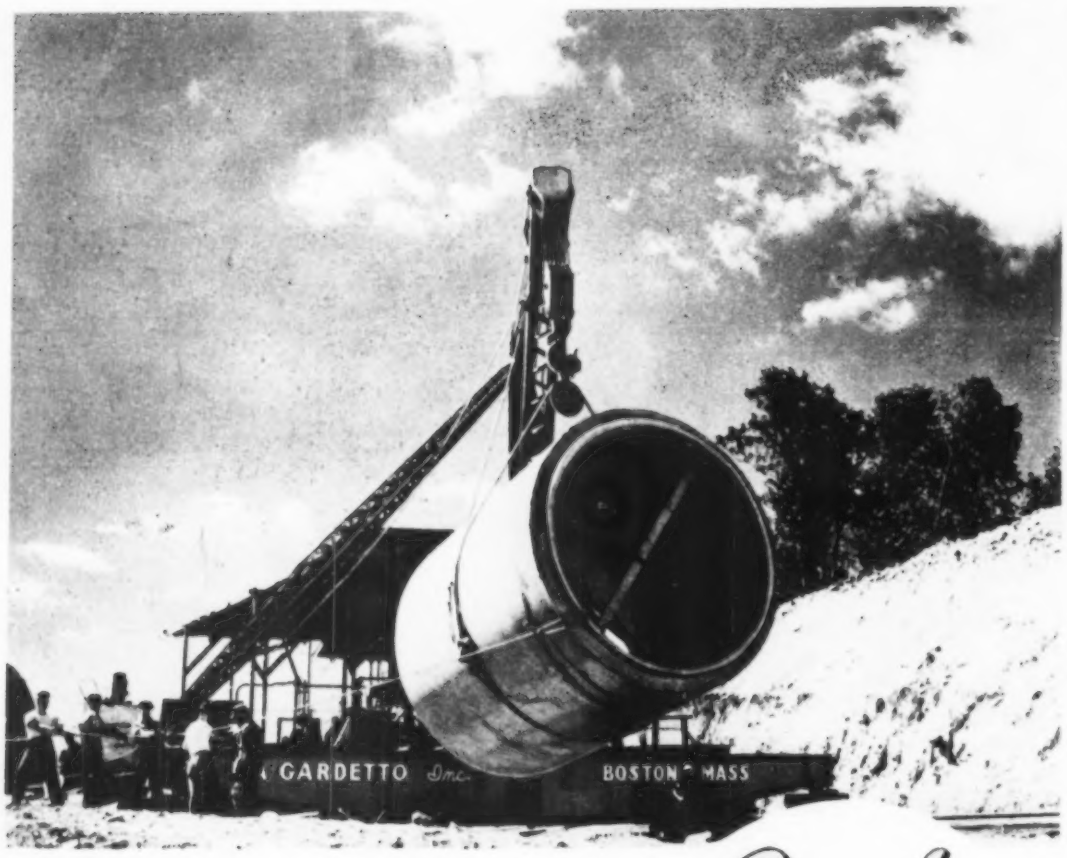

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PERFECT GRIP DROP-FORGED STEEL HOT GALVANIZED

(Continued from page 103)

shown by the large increase in the actual over the theoretical water-carrying capacity.

The number and spacing of drill holes was varied with the character of the rock. The number of holes per round varied from 21 in soft decomposed formations to 44 in the hardest rock. Drilling diagrams for these two extremes are shown. A four-hole pyramidal cut was standard, the number and spacing of the holes surrounding the cut being varied to suit the rock.

Job-Designed Drill Carriage

All drilling at the face was done from a drill carriage or jumbo designed by the company's construction department for use on previous tunnels and adapted to use on this job. This jumbo has a steel frame mounted on a four-wheel truck of 30-in. gage. Three horizontal pieces of extra heavy 4-in. pipe cantilever out 10 ft. from the car body at a height of 6 ft. above rail and two pipes are mounted the same way 15 in. above the rail. These bars are pivoted at the rear end so that they can be fanned out radially in a horizontal plane. A rock drill is mounted on each of these radial bars by standard clamps and short vertical bars. A steel framed wooden deck, just below the top bars, 8½ ft. wide with folding sides, serves as a working platform for the drillers.

Compressed air is brought to the jumbo from the supply line through a 2½-in. hose, thence through a receiver tank to manifolds equipped with line oilers on the top and bottom decks. Short lengths of 1-in. hose lead from the manifolds to the drills. Water connection to the jumbo is made through a 1-in. hose with similar water manifolds. Floodlights are mounted on the top and bottom decks so that it is only necessary to plug a cord into the lighting circuit to have light where it is needed. The body of the jumbo over the trucks is equipped with racks for drill steel sufficient to complete a round, tools, two spare rock drills, loading sticks, blow pipes and, in fact, everything necessary to drill the round. In downhill headings a 1½-in. duplex air pump, complete with suction and discharge hoses, is placed on the rear end of the carriage.

A drill crew of 12 men was made up of 5 drillers, 5 drillers' helpers, 1 nipper and a shift boss. There also was an electrician in the heading at all times. The drilling and blasting cycle was as follows:

Upon completion of mucking, the drill jumbo loaded with sharp steel was pushed up to the face by a storage-battery locomotive. The drillers and their helpers immediately set up the drills in position while the nipper connected air, water and light lines to the jumbo and, if necessary, started the drainage pump. This operation of setting up required 18 min. on the average. Each driller started drilling as soon as his machine was set up and continued until he had completed his quota of holes, when he dismounted his machine and blew out the holes.

After all drilling had been finished, the

(Continued on page 106)

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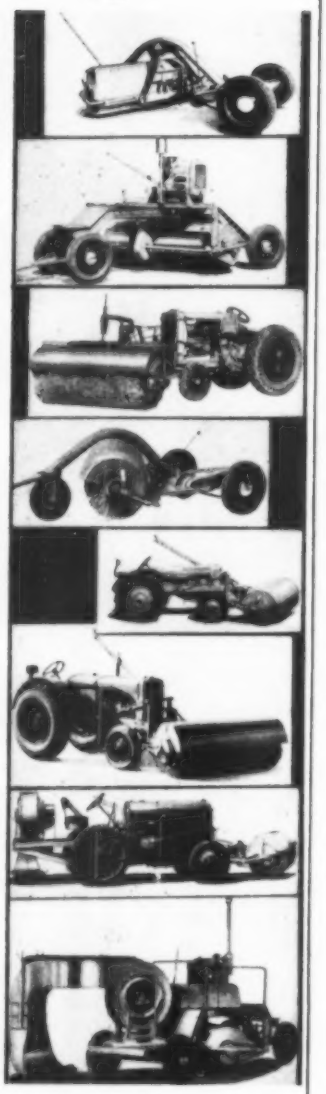

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Since 1920

(Continued from page 104)

jumbo was drawn back a few feet, air and light lines disconnected, special loading lights hung behind the jumbo and the holes were loaded by the miners, under supervision of the shift boss. Exploders were connected to bus wires by the miners and connections checked by the shifter and electrician. The loading time averaged 18 min. The jumbo then was hauled out of the tunnel to the tool-sharpening shop near the adit. Dull steel was exchanged for sharp, drills were serviced and the carriage was cleaned up ready for the next round.

Explosives, purchased in car-load lots, were stored in powder houses of 50-ton capacity in the vicinity of the job. The explosive required for each day's operations was transferred daily to small powder houses near the adits. Gelatine dynamite, 40 and 60 per cent strength, was used on the first section, after which 45 and 60 per cent strength, semi-gelatine type explosives were substituted with a slight saving in cost. Primer cartridges were made up in 60-per cent gelatine dynamite with No. 6 strength electric exploders from zero to ten delay. Primers were prepared by a full-time powder man, one-day's supply at a time. Sufficient explosives for each round were taken into the tunnel with the jumbo in small, steel-frame, spring-mounted powder cars with all-wooden bodies.

GENERAL DATA ON STANISLAUS TUNNEL

Total length of tunnel	57,515	ft.
Total length of adits	566	ft.
Total length tunnel and adits	11	mi.
Total number of rounds	6,982	
Total number of drill holes	263,887	
Number of cubic yards excavated (solid)	247,340	cu. yd.
Total amount of powder used	2,099,500	lb.
Average advance per round	8.24	ft.
Average number of holes per round	37.8	
Average amount of powder used per cubic yard	8.5	lb.
Total length of sidings cut	4,732	ft.

There were some missed holes and occasionally unexploded cartridges were found in the muck pile, but there were no accidents from these causes. So that unexploded powder might not be mistaken for stemming, the latter were made up by filling red paper shells with loam to distinguish them from the grey powder cartridges. Blasts were fired by the electrician from a safety switch on the 440-v. circuit located about 2,000 ft. back from the face. This switch was so constructed that it could be closed only by carrying an extension cord across the track and plugging it into the switch box on the opposite wall.

Rock drills were automatic-feed, Gardner-Denver machines with a 3½-in. piston. Trials were made with 4-in. piston machines and these were found to be 8 per cent faster in actual drilling. However, the increased weight and consequent difficulty of handling them increased their

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THIS book provides a simple chart system that gives construction costs at a glance and takes long and tedious headwork out of estimating. Over 400 of the charts are given in ready form for handy use, and cover the estimating of transportation, labor and material costs for all kinds of construction work. The book also presents a complete model estimate for a typical small building, together with a step-by-step description of the methods followed in making it.

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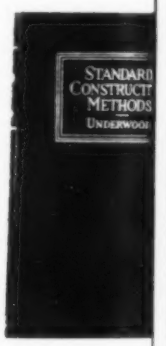

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overall drilling time by almost 10 per cent.

Originally only four drills were mounted on the jumbo. This gave the drillers on the top deck one more hole apiece than those on the bottom which, coupled with the increased difficulty of handling the machines on the top deck, delayed completion of the top holes until 20 or 30 min. after drillers on the bottom had finished. A fifth drill then was added to the top which made a more even distribution of holes, speeding up the top so that all drillers finished at about the same time.

Drill Maintenance and Repair

One or two spare drills always were carried on racks on the jumbo provided for that purpose. No drill repairs, other than changing an occasional water needle, were made in the heading. Broken drills were exchanged for one of the spares and the broken drill in turn was exchanged for another at the machine doctor's shop at the adit. A full-time machine doctor kept all drills in first-class condition. All drills were washed off and oiled after every round.

The tool sharpeners shop was equipped with three sharpeners; two Gardner-Denver and one Ingersoll-Rand machines. Although housed under one roof, the shop was in reality three complete sharpening units, one for each heading, with a third set up for shanking and making up new steel. The sharpening sections had two shifts of two men each, while a single two-man shift took care of the shanking. An average of 510 pieces of steel was sharpened by each shift for each heading, although in drilling some of the hard diorite formations as many as four sets of steel were needed for each hole or about 800 pieces of drill steel for a single round. On the 11-mi. tunnel, 143 tons of 1¼-in. round, hollow drill steel was consumed. This is at an average rate of 6 lb. per foot of tunnel or 1.16 lb. per cubic yard of solid excavation.

In spite of the remarkable speed of driving, there were very few accidents and none of them was serious. The total cost of first aid, physical examinations, medical care and compensation paid to underground workers was only 5.14 per cent of the labor cost. This rate was reduced from 6.89 per cent in the first section of the tunnel to 3.59 per cent on the third. This improvement was due largely to the decrease in the number of drilling accidents, mainly, finger injuries caused by (a) drillers getting fingers caught in

(Continued on page 108)

LENGTH OF SECTIONS AND HEADINGS

Section	Driven From Adit No.	Direction	Length of Headings, ft.	Total Length of Sections, ft.
		West	6,625.0	
1	5	East	11,647.4	18,272.4
		West	7,366.1	
2	3	East	12,123.2	19,489.3
		West	11,274.2	
3	1	East	8,479.0	19,753.2
		Grand Totals....	57,514.9	57,514.9

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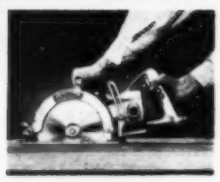
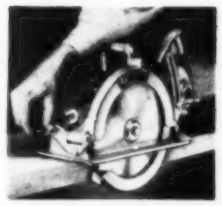
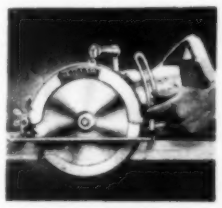


Handle at the rear provides perfectly natural control of Skilsaw in all positions for more accurate cutting. The position of the top handle keeps operator's guide hand away from the blade, on both straight and bevel cuts.



Bevel-cutting is easy and quick with Skilsaw — the bevel adjustment is controlled by this one wing-nut on a scale that is graduated up to 45°. That's why you save so much time cutting ¼, ½, ¾, and full pitch rafters.



Telescoping guard rotates automatically on ball bearings—Skilsaw is always safe and sure. Base is supported at front and rear for rigidity and accuracy; adjusted for depth of cut by loosening one wing-nut!

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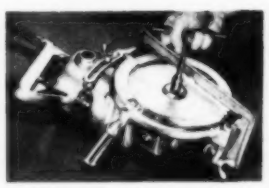

Changing the Skilsaw blade is simple—just take out the stud bolt without removing any screws or other parts. Blade is on the left side of machine, so you can see line of cut clearly, saw accurately in all positions!

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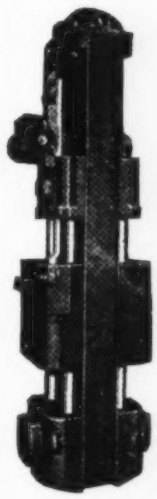

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(Continued from page 107)

the drills as drills were pulling the steel out of the hole and (b) helpers holding the drill to start a hole. These two causes were almost entirely eliminated by (a) welding a plate on the drills over openings where fingers were caught and (b) equipping the drills with centralizers which held the steel when a hole was started. Accident costs, in per cent of labor costs, for the three sections of the tunnel are tabulated.

Personnel—The Stanislaus Tunnel was constructed by the forces of the Pacific Gas and Electric Co. under the direction of O. W. Peterson, engineer of general construction, with Hector Keesling as assistant. J. E. Cooney was field superintendent and Harry Scott was tunnel superintendent. The writer was resident construction engineer on the project.

TIME STUDY PER ROUND ADVANCE, SINGLE-HEADING METHOD

	SECTION 1 (Both Headings)	SECTION 2		SECTION 3	
		East	West	East	West
Length of Sections (ft.)	18,272	10,492	5,890	4,779	7,871
	(TIME IN HOURS AND MINUTES)				
Moving in jumbo and setting up drills	0:18	0:18	0:18	0:18	0:18
Drilling	2:54	2:27	2:08	2:08	2:35
Loading holes and blasting	0:18	0:18	0:18	0:18	0:18
Clearing heading of gas	0:18	0:15	0:15	0:15	0:15
Mucking	1:27	1:46	1:42	1:37	0:46
Time off for meals per round	0:17	0:17	0:15	0:15	0:15
Delays per round	0:05	0:05	0:02	0:02	0:03
Total time for one round	5:37	5:26	4:58	4.53	5:32
Number of rounds per day	4.28	4.42	4.83	4.91	4.34
Depth of holes (other than cut) (ft.)	7 to 10	10	9	9	10
Average advance per round (ft.)	7.61	8.85	8.70	8.31	9.01
Ave. number of drill holes per round	36.3	39.4	37.3	40.2	41.3
Ave. length of drill holes per round (ft.)	344	401	338	364	418
Drilling speed (ft. of drill hole per min.)	1.25	2.73	2.64	2.85	2.70
Man-hours per round	146	141	129	127	144
Powder per cubic yard — 60% (lb.)	3.42	5.70	2.50	3.38	5.40
Powder per cubic yard — 40% (lb.)	4.16	3.92	6.25	4.98	3.60
Powder per cubic yard — total (lb.)	7.58	9.62	8.75	8.36	9.00

Average men per shift each heading, 26 (Underground, 17; surface, 9)

TIME STUDY PER ROUND ADVANCE, ALTERNATE HEADING METHOD, SECTION 3

	MONTH				
	Sept.	Oct.	Nov.	Dec.	Jan.
Number of Days Worked	23	25	23	26	6
Distance advanced (ft.)	1,443	1,567	1,450	1,592	314
	(TIME IN HOURS AND MINUTES)				
Move in jumbo and set up drills	0:23	0:10	0:14	0:23	0:31
Drilling	2:17	2:22	2:10	2:10	2:26
Loading holes and blasting	0:18	0:18	0:18	0:18	0:18
Move crew to other heading	0:03	0:03	0:08	0:10	0:12
Time off for meals per round	0:12	0:12	0:12	0:14	0:16
Delays per round	0:05	0:01	0:00	0:02	0:05
Total time for one round	3:18	3:06	3:02	3:17	3:48
Distance between headings (ft.)	960	2,465	3,975	4,500	5,450
Number of rounds per day	7.27	7.74	7.91	7.32	6.32
Depth of holes (other than cut) (ft.)	9.5	9.5	9.5	9.5	9.5
Average advance per round (ft.)	8.65	8.20	7.96	8.28	8.25
Average number of drill holes per round	38.9	40.3	39.7	40.9	47.4
Average length of drill holes per round (ft.)	389	403	375	409	458
Drilling speed (ft. of drill hole per min.)	2.84	2.84	2.88	3.15	3.14
Man-hours per round	109	109	106	115	133
Powder per cubic yard — 60% (lb.)	4.14	5.13	5.33	4.90	4.18
Powder per cubic yard — 40% (lb.)	4.29	4.51	4.19	4.96	4.07
Powder per cubic yard — Total (lb.)	8.43	9.64	9.52	9.86	8.25

Average men per shift, 35 (Underground, 26; surface, 9)

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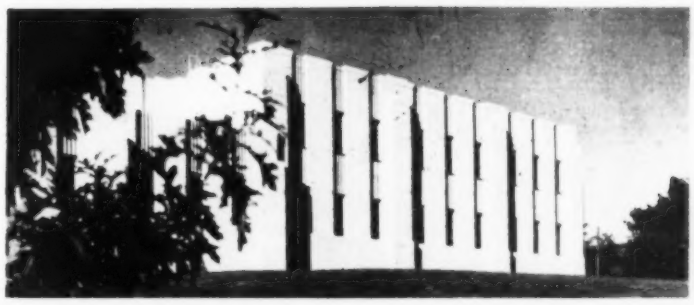

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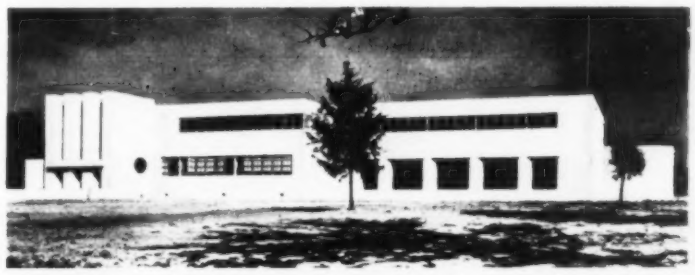

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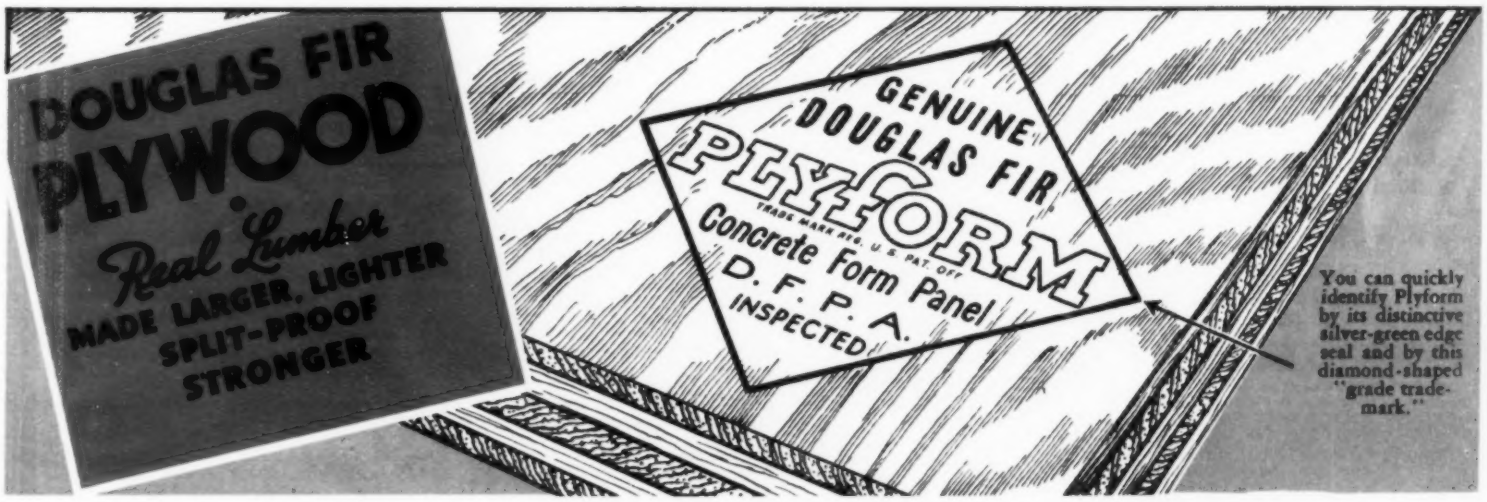

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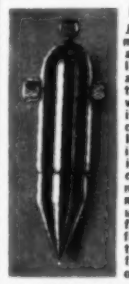

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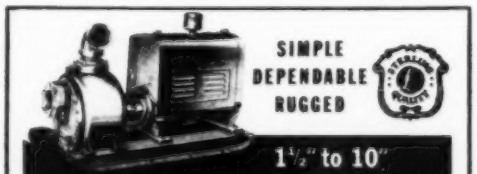

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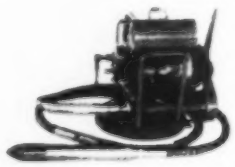

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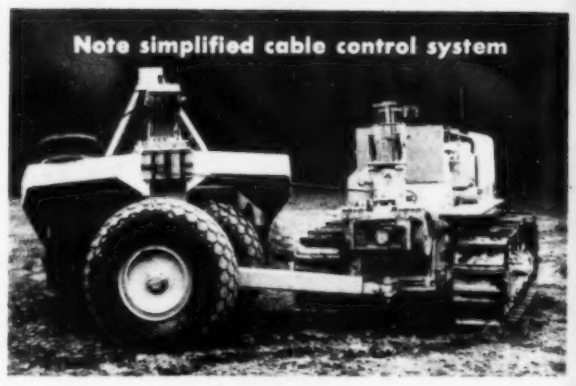

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